NOLOGY DEPT

ROADS AND STREETS

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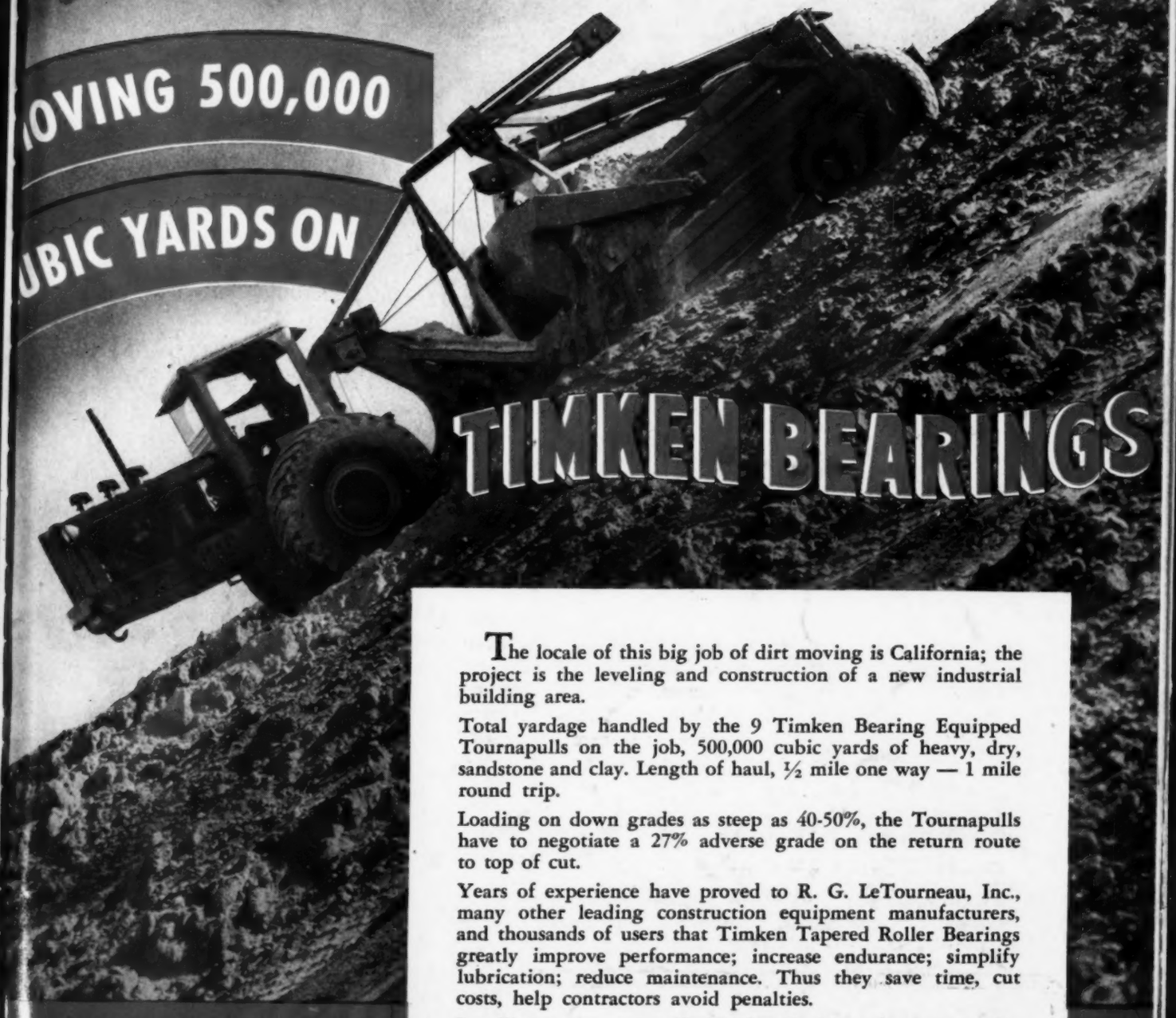

The locale of this big job of dirt moving is California; the project is the leveling and construction of a new industrial building area.

Total yardage handled by the 9 Timken Bearing Equipped Tournapulls on the job, 500,000 cubic yards of heavy, dry, sandstone and clay. Length of haul, ½ mile one way — 1 mile round trip.

Loading on down grades as steep as 40-50%, the Tournapulls have to negotiate a 27% adverse grade on the return route to top of cut.

Years of experience have proved to R. G. LeTourneau, Inc., many other leading construction equipment manufacturers, and thousands of users that Timken Tapered Roller Bearings greatly improve performance; increase endurance; simplify lubrication; reduce maintenance. Thus they save time, cut costs, help contractors avoid penalties.

It will pay you to specify Timken Bearings for your equipment — and to make sure the trade-mark "TIMKEN" appears on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

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TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

R v.89 No. 2 July-Dec. 1946

SMOOTH LANDINGS ASSURED WITH ADAMS GRADING THE JOB

★ Pictured above is a typical airport construction job, with an Adams Motor Grader building the landing strips.

This particular job is on the Patton Brook Airport, Plainville, Conn., where three large landing strips are now under construction. With a main landing strip 600 ft. wide by 3000 ft. long, Patton Brook will be one of the largest privately-owned airports in New England when completed, capable of accomodating planes up to the Army's C-47.

In the course of the next seven years, thousands of airports are to be built or enlarged in this country, under the CAA national airport program. Obviously, this is going to mean a lot of extra business for alert contractors. Many of these contractors will choose Adams Motor Graders for their work . . . because they know that Adams have everything it takes for smooth, accurate, high-speed grading—the kind that pays off in faster, better jobs and higher profits.

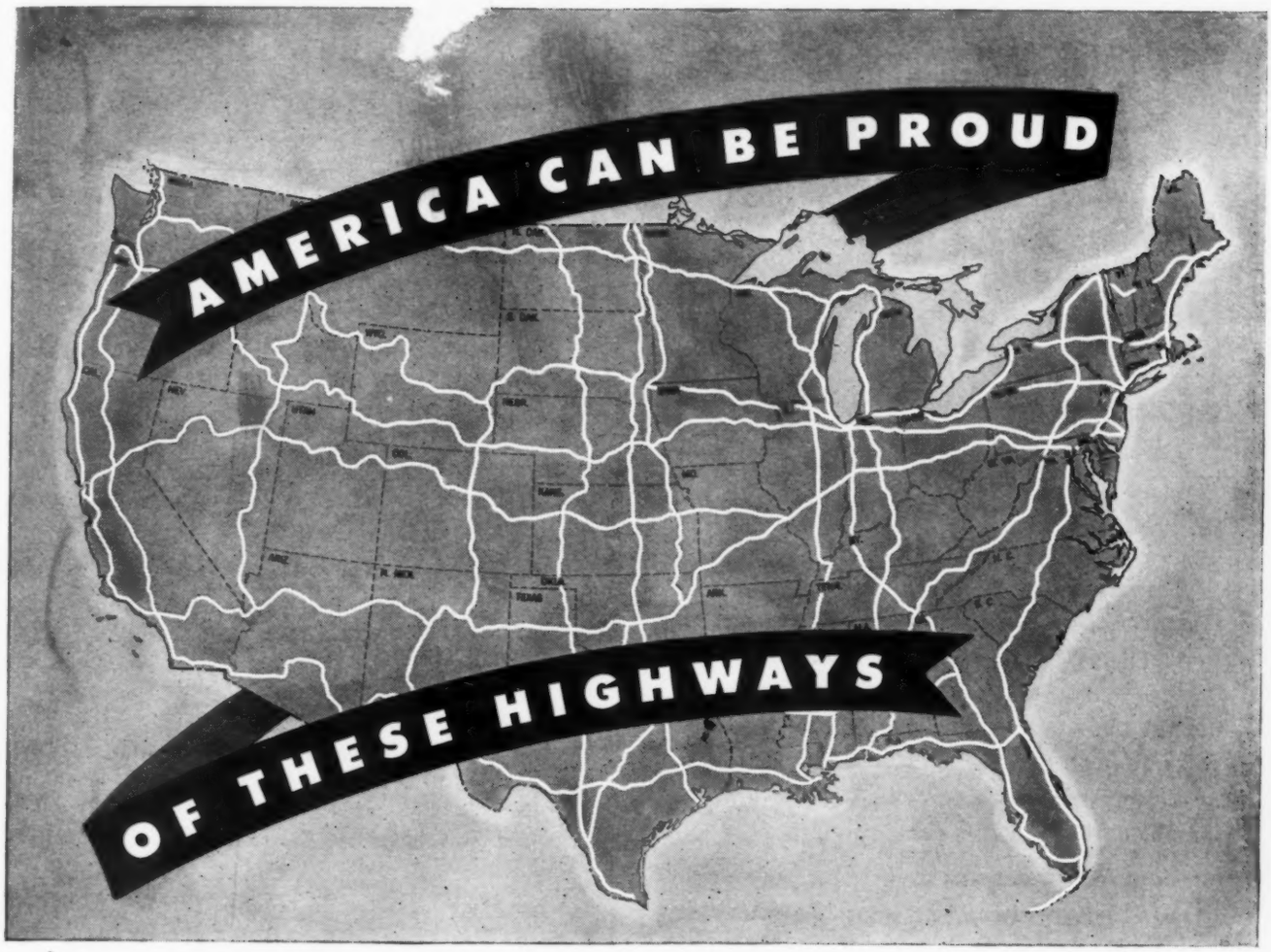
Get the complete time-saving, money-saving facts from your local Adams dealer. You'll find there are no finer motor graders built—*at any price.*

J. D. ADAMS MANUFACTURING CO., INDIANAPOLIS, IND.

ADAMS

ROAD BUILDING AND EARTH-MOVING EQUIPMENT

Tech.



Shown on the map above are a few of the principal highways of the great U. S. highway network, now 30 years old and begun with passage by Congress of the Federal-Aid Road Act in 1916. And it's just 20 years since U. S. highways have been uniformly marked, with north-south routes given odd numbers from 1 to 101, and east-west routes even numbers from 2 to 90. U. S. feeder routes have higher numbers with final digits referring to the main roads they serve.

There's a lot of history and romance in our highways, many of them following old wagon trails of pioneer days. What tourist, planning a long motor trip, hasn't thrilled to vistas opened up by U. S. 1 . . . U. S. 11 . . . U. S. 41 . . . U. S. 2 . . . U. S. 30 . . . U. S. 40 . . . ribboning away for hundreds of miles, up and down and across the land? And what businessman or salesman, traveling long distances by automobile, hasn't been conscious of the benefits afforded by Federal highways?

By supplying contractors with the steel products needed for modern concrete roads and for bridges of all types, Bethlehem has had a part in the building of many of the important links in our national highway system. Today, with so many highways to be repaired or relocated, and new bridges built, Bethlehem again offers well-rounded service and a line of road steels designed and built for top-notch performance. If you have a highway job coming up in the near future, we suggest you get in touch with the nearest Bethlehem district office.

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On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

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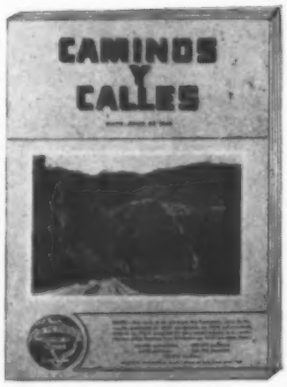

CAMINOS Y CALLES goes as a good-will builder for you to a special group of public officials, engineers, contractors and equipment distributors concerned with building, improving and maintaining the highways of Latin America.

It is printed in Spanish with a section in Portuguese. Manufacturers of equipment and materials seeking an export market can reach the key buyers through CAMINOS Y CALLES without waste circulation. It is distributed to all Latin American countries and furnishes a CCA audit of 10,700 circulation.

Large credit balances have been built up in the U. S. by these Latin American countries. They are in need of all types of road building equipment—and they like it American made!

New — Catalog Issue

A new Reference and Data Catalog section will be incorporated in an early 1947 issue of CAMINOS Y CALLES. This will give the manufacturer a place for his Catalog message to this specialized group—a year-round-interest issue. Be sure to plan for this special issue in your 1947 budget.

Write for particulars on Caminos y Calles and on new Reference and Data issue.

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ROADS AND STREETS

No. 7 JULY, 1946 Vol. 89

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A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations, and to the construction and maintenance of airports.

WITH ROADS AND STREETS HAVE BEEN COMBINED GOOD ROADS MAGAZINE AND ENGINEERING & CONTRACTING

HALBERT P. GILLETTE, President; EDWARD S. GILLETTE, Publisher; HAROLD J. McKEEVER, Editor; CHARLES T. MURRAY, Managing Editor; H. K. GLIDDEN, Eastern Editor (N. Y.); LT. COL. V. J. BROWN, Publishing Director (Absent on Military Duty); H. J. CONWAY, Advertising Editor; L. R. VICKERS, Promotional Director.

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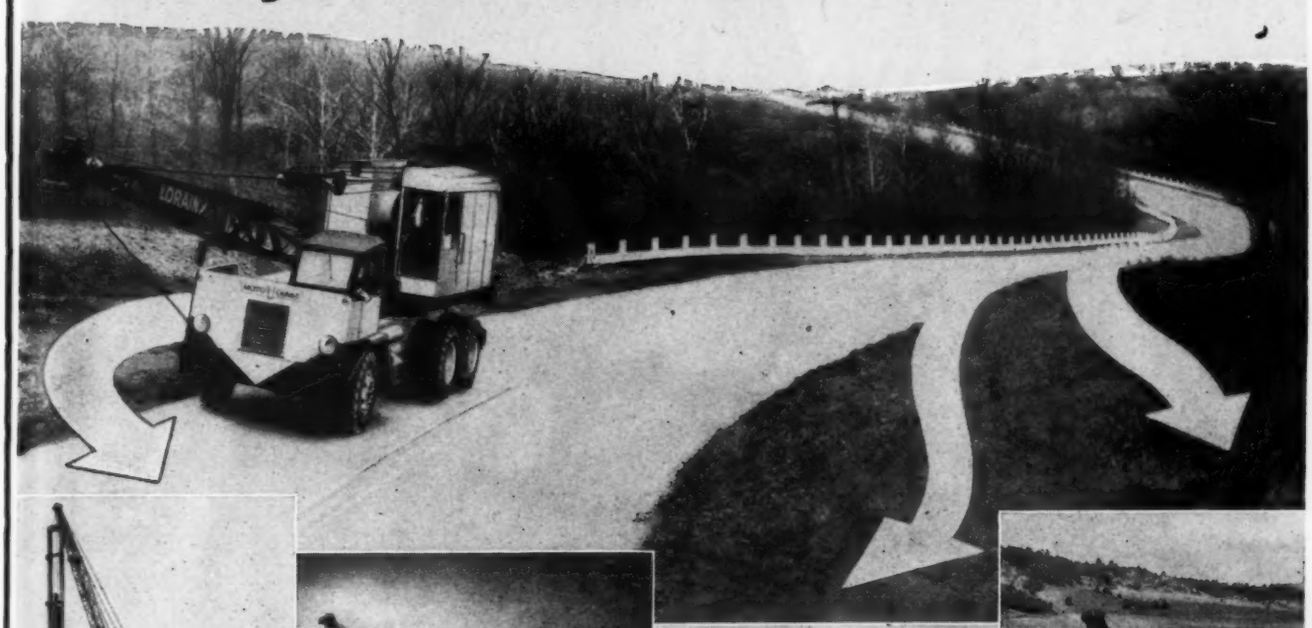
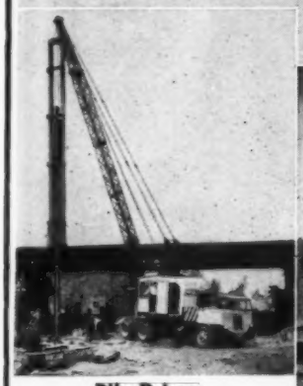
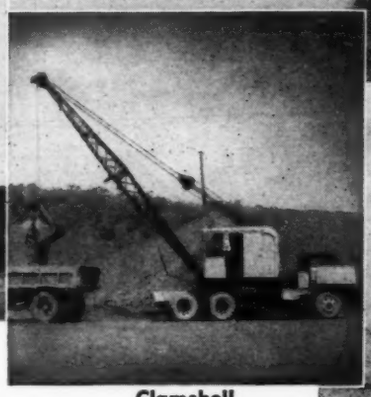
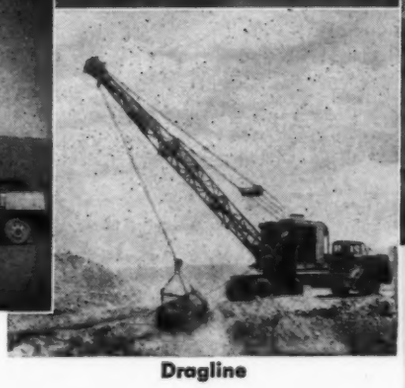




Pile Driver



Clamshell



Dragline

Shovel

The new 20-ton 6-wheel drive Moto-Crane.

The 2-speed crawler mounted Lorain

The 20-ton rubber-tired, Self-Propelled Crane.

IS it a case of too many jobs or too little mobility? With *one* Moto-Crane you can cover many different kinds of jobs in widely separated areas speedily, smoothly and at a saving.

Moto-Crane mobility makes it independent of all other forms of transportation. Soft ground flotation and high tractive effort give off-the-road travelability that gets this unit to the job whether there's a road or not. When finished it takes off for the next job under its own power over hard roads at speeds up to 31 m.p.h. Its uses are legion — general excavation, car unloading, steel erecting, ditching, bin charging, pile driving, etc.

Put a Moto-Crane to work and *mobilize* those scattered jobs into one efficient operation. There is a wide range of models and capacities to choose from mounted on 4 or 6 wheel units with or without front wheel drive. Ask your local Lorain distributor for complete Moto-Crane information today.

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A hundred thousand dollars worth of equipment waiting on that Batcher Plant—when the plant stops the job goes dead!

You can't *afford* anything but the best in cranes to keep it loaded. You're going to need a Northwest! See a Northwest at work. Talk to Northwest owners! Make a note of their satisfaction.

Northwests are fast, smooth in operation. Uniform Pressure Swing Clutches eliminate the jerks and jars present with ordinary swing clutches and assure longer life, smoother operation and less time down for replacement or adjustment. The "Feather-Touch" Control assures ease of handling, retains the feel of the load and eliminates shut downs due to control failures. Northwest Crawlers easily negotiate the rough going of aggregate piles and roadways cut up by trucks—and remember one out of every three Northwests is a repeat order with a responsible contractor. There is no better testimonial to service.

Make your plans well ahead so you can have a Northwest when the big pressure comes on.

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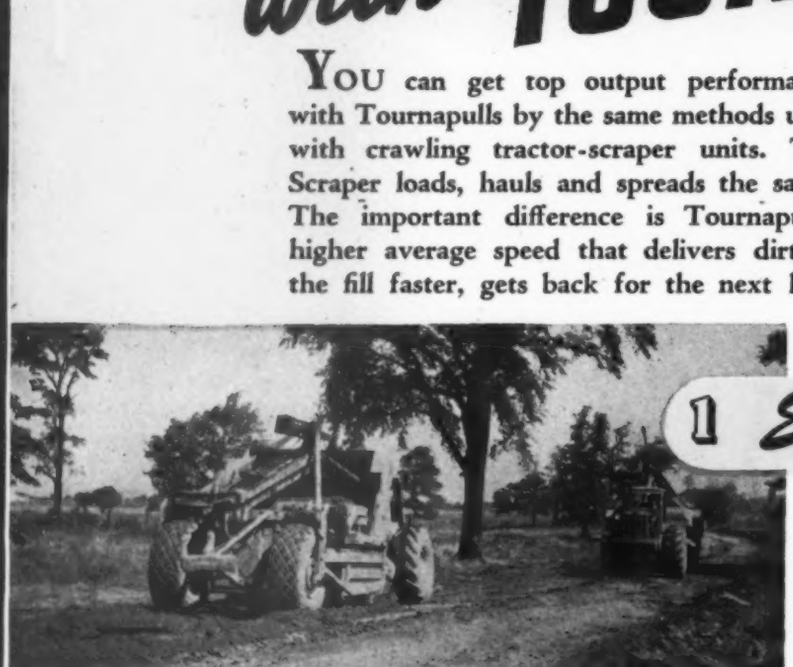
SHOVELS • CRANES • DRAGLINES • PULLSHOVELS

If you have a REAL ROCK SHOVEL you never have to worry about output in dirt!

HOW TO GET *lowest net cost per yard* *with* TOURNAPULLS

YOU can get top output performance with Tournapulls by the same methods used with crawling tractor-scraper units. The Scraper loads, hauls and spreads the same. The important difference is Tournapull's higher average speed that delivers dirt to the fill faster, gets back for the next load quicker. Tournapull jobs are easy to manage . . . easy to keep at top performance efficiency by applying simple, job-proved methods illustrated here. These easy operating short-cuts enable you to take fullest advantage of Tournapull speed . . . move more dirt at lowest net cost per yard:



Contractor Frank Mashuda maintains good haul roads for high speeds at Mansfield, Ohio, airport.

1 *Easy* to have smooth haul roads

Good haul roads pay whether you use crawlers, trucks or Tournapulls. With their giant low pressure tires, powerful Tournapulls pull through soft mud holes and over roughest of trails. But, like any other rigs, if you maintain smooth haul roads Tournapulls go faster, move more yards, with less maintenance, downtime and operator fatigue. Use your Tournapulls to fill in low spots . . . cut down the bumps during normal cycle of operation. You'll find Tournapulls' big tires protect surface, don't cut in.

Big load . . . fast get-away on Frederickson & Watson's California Naval project.

C. T. Wilson Contracting Co. spots Tournapulls for efficient snatch loading on Decatur, Ill., airport.

2 *Easy* to load and get going

With crawling tractors or Tournapulls, good operators get their load and get going. Heap the load . . . sure, but when dirt starts side-spilling and windrowing from blade ends, it's time to pick up and go. Fast get-away is easy with Tournapull's quick acceleration and low dead-weight that gets you into high-speed gear fast . . . shortens cycle time to make more trips. Pusher blade can maintain smooth, fast exit runways in spare time. It pays. It's easy.

3 *Easy* to cut waste motion

Like all scrapers, Tournapulls get bigger loads faster with aid of a pusher or snatch tractor. You get even more work from your tractor if you spot the second Tournapull right alongside where the first one leaves off, as shown here. This way, the tractor swings over, or does a short U-turn, and gets back into production fast. Tournapull maneuverability makes it easy to spot for efficient loading with minimum waste motion in the cut.

C38

4 *Easy* to use straddle loading

You can relieve side-binding in cut to load material faster and easier. Leave 4 or 5-foot ridge between successive scraper cuts. Material left between the cuts will be loosened. Then, straddle the ridge and carry cut down below surface of adjoining troughs. Bottom of old trough becomes top of new ridge. It's easy to do with fast, straight-cutting Tournapulls.

Here's how U. S. Engineers used straddle-loading method to cut loading time in Georgia.

5 *Easy* to load downhill

Gravity helps you get heaped-capacity Carryall Scraper loads quicker by loading downhill. Downgrade acts as extra loading force . . . lets you take a deeper cut, boil material in faster. Plan cuts for faster downhill loading wherever possible, take advantage of favorable grade to add to Tournapull's exceptionally quick take-off into high-gear travel.

Downgrade loading heaps Carryall bowl fast for S. R. Batson Co., of Birmingham, Ala.

6 *Easy* to root for loading

Struggling to drive a cutting edge through hard material is no more economical with Tournapulls than with old-style tractor scrapers or a shovel dipper. Tough materials that normally slow down output, can be easily broken up with a powerful, job-proved LeTourneau Rooter. Rooter will more than pay for itself in extra Tournapull yardage moved.

Circle Construction Corporation roots frozen sand on New York Idlewild Airport.

7 *Easy* to keep rolling

Tournapulls are simpler, have less moving parts less exposed to abrasion and are easier and less expensive to keep up than other dirtmovers. But, it's just as economical to take good care of them. Make periodic adjustments recommended in maintenance manuals, inspect tires and cable regularly, lubricate on schedule, keep PCU in adjustment, use the trained service of your LeTourneau Distributor to keep your job high-balling at top speed.

● ***Use these tips to take fullest advantage of Tournapull production possibilities for lowest net cost per yard. It pays.***

Regular lubrication and maintenance pays Ralph Rogers & Co. on Bloomington, Ind. levee project.

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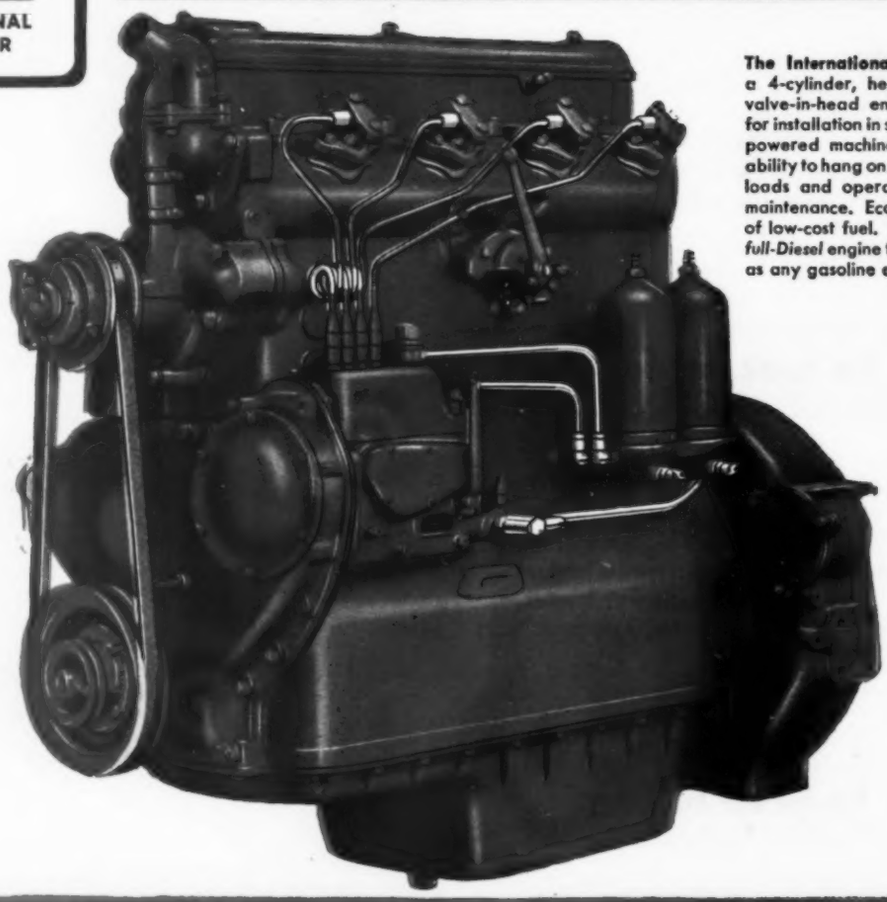

The International UD-14 Diesel, a 4-cylinder, heavy-duty, 4-cycle valve-in-head engine, as supplied for installation in self-propelled and powered machines. It has unusual ability to hang on under heavy overloads and operates with minimum maintenance. Economical in its use of low-cost fuel. Easily serviced. A *full-Diesel* engine that starts as easily as any gasoline engine of like size.

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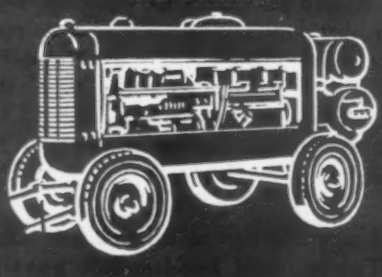

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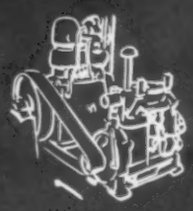

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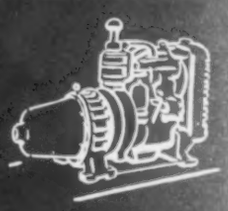

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for Full-Diesel Economy

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International Diesels are smooth-running, 4-cycle, *full-Diesel* engines. Advanced design fuel injection and combustion assures full use of the fuel consumed. And International's positive, instant starting system makes any International Diesel as easy to put to work as any gasoline engine of like size and horsepower. That means no excess weight, no wasted time, no hesitation when you want power on the job!

There are many features that give International Diesel engines long life with minimum maintenance. *Tocco-hardened crankshafts; valve-in-head design; replaceable, long-life cylinders of heat-treated alloy steel; full-pressure lubrication through rifle-drilled passages; heavy-duty precision bearings of replaceable type; full-floating piston pins; full-floating water pump shaft; by-pass type thermostatically-controlled cooling; large-capacity air, oil and fuel filters; etc.* Only International Diesels have all these features!

Any powered equipment is, therefore, better equipment because of the dependable International Diesel Engine that powers it. Visit any distributor who handles International-powered equipment for further facts and help in selecting the equipment you need. For International Diesel Crawler Tractors, Wheel Tractors or Power Units, see your nearest International Industrial Power Distributor.

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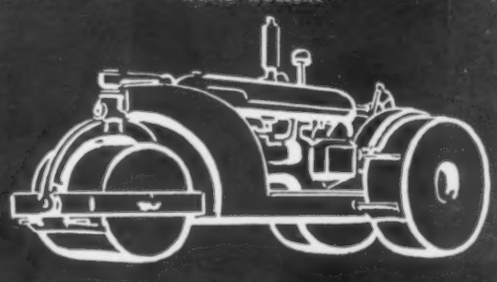

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CLEVELAND CLAY AND TRENCH DIGGERS

Take it Out in a Hurry!

Model CD8
Weight, 22
Pounds

Model C10D
29 Pounds

Model TD8
26 Pounds

Model C10E
36 Pounds

★ For loosening up hard ground or tough clay, these tools are real time and money savers. There are four types to choose from—a good digger for every condition. Model CD8 is recommended for average work, for caisson jobs, wall trimming, and similar digging. The TD8, with the extension handle, is just right when the operator has a chance to stand erect in his work. C10D, with the spade handle, and the C10E long-handle digger, are for the tougher job.

Cleveland No. 5 Back Fill Tamper weighs 30 lbs. with butt.

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Ram all the Dirt Back Firmly!

★ Whenever construction work or paving must proceed immediately after back-filling, Cleveland Tampers will prove to be the answer to your problem. They ram the earth even firmer than it was originally, making it safe for your job to go ahead. And you won't have any dirt to haul away!

Bulletin 128 provides full information on the Cleveland Line of Diggers and Tampers. Promptly sent on request.

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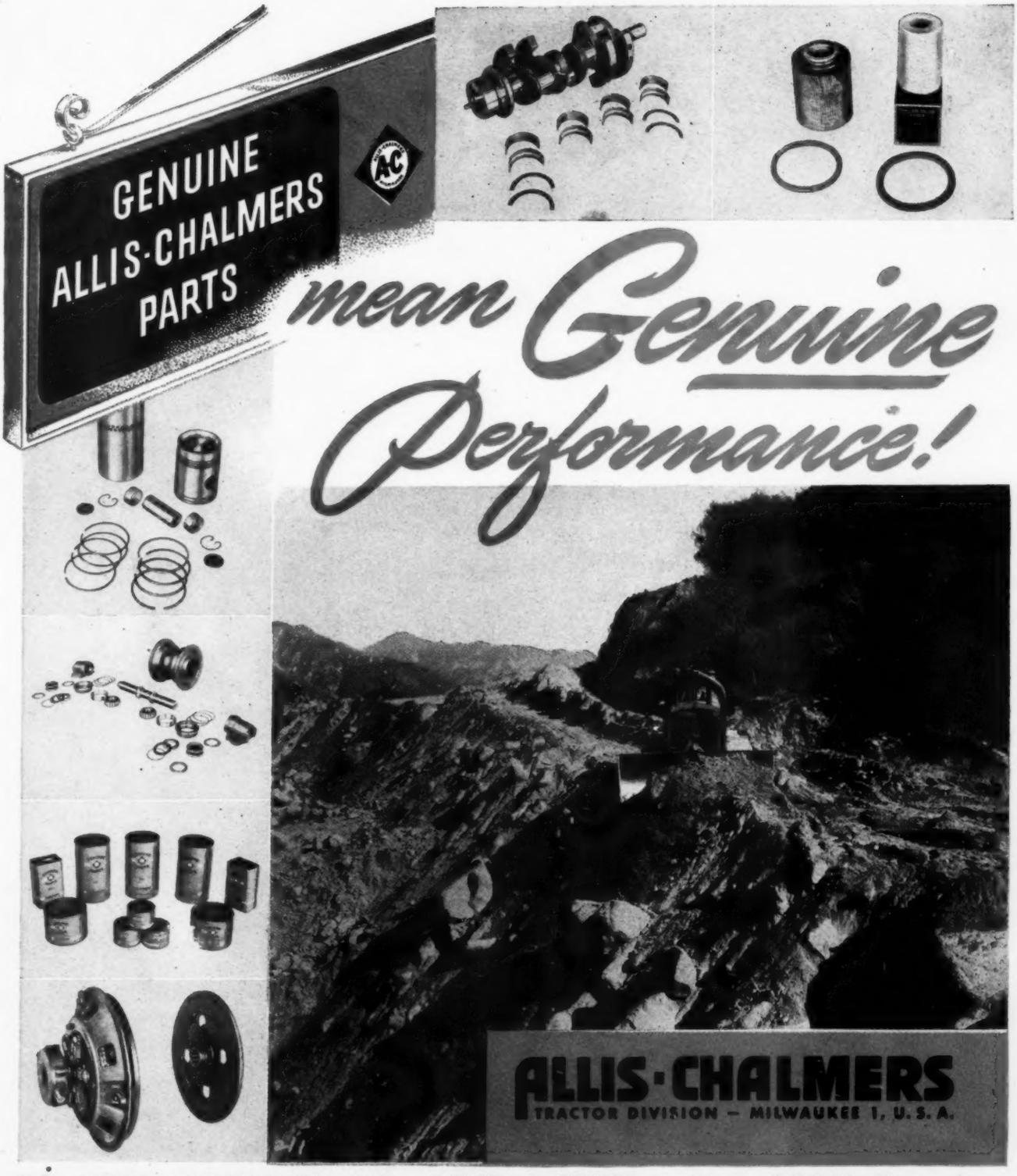

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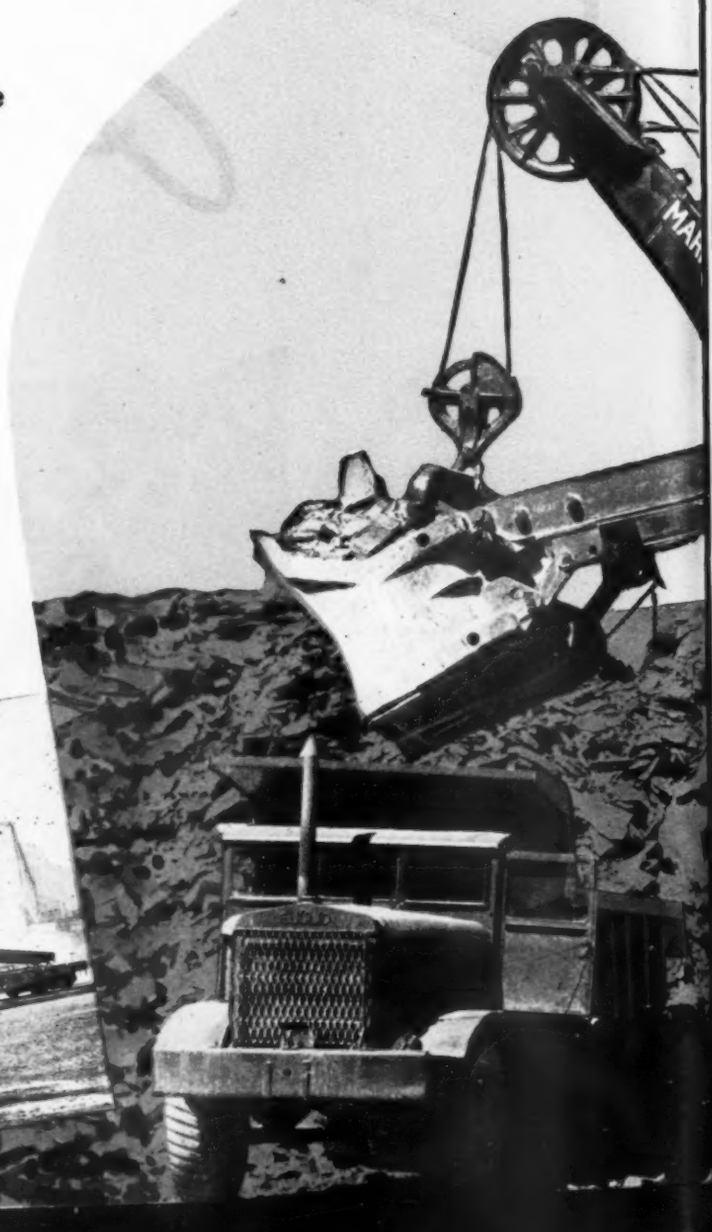
Your Allis-Chalmers tractors are built to give years of service on toughest work, day after day, at lowest upkeep. To maintain this top-notch performance, replace parts, as wear occurs, with Genuine A-C parts. Designed specifically for Allis-Chalmers tractors, they are of the same high-quality material, built to the same rigid specifications of original parts, by the same skilled men, in the same factory. Specially treated and packaged, they are protected from damage, rust, dust, dirt!

Remember — there is no substitute for the real thing!

Keep your A-C tractor Genuine with Genuine A-C parts . . . keep yardage up, keep cost down.

You asked for it! Here it is! A new, fast, powerful

Here is a modern, heavy duty Diesel machine that is a top yardage producer in mining, quarrying, and heavy construction. It has the power—speed—and rugged strength to out-perform anything in its class under all digging conditions. It is a REAL MARION through and through. The MARION 111-M is easily and quickly convertible to dragline service. It ships without major dismantling. Let us tell you more about this outstanding performer.



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111-M

3½-4 yd. Diesel Shovel

That has everything!

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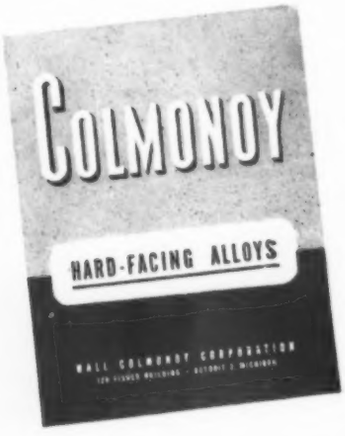
HARD-FACE your worn TRACTOR SPROCKETS by the COLMONOY FORMWELD PROCESS

—and increase their life by upwards of four times—at approximately the cost of a new replacement.

The Colmonoy Formweld Process was used extensively by the U. S. Army for hard-facing tank sprockets. Now it is available to you.

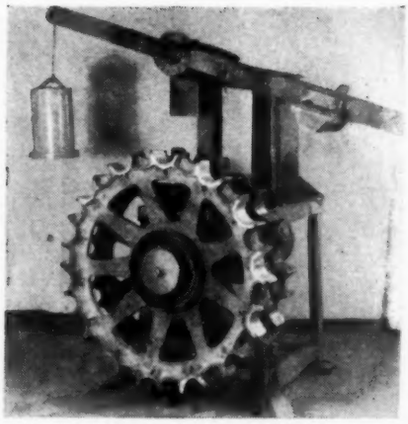
It is made possible by the wide "plastic range" of the wonder metal, Colmonoy No. 6. Between temperatures of 1850° and 2050° F. this remarkable alloy is plastic, and may be die formed and hot wiped.

The best prescription for tired, worn sprockets is to rebuild them with Colmonoy after they have worn down 3/16" to ¼". If many of the same type are to be rebuilt, a jig, similar to the one shown at the right, insures a perfect replica of a new sprocket. The job can be done satisfactorily by hand welding, because of the excellent weldability of Colmonoy No. 6, where the number of sprockets to be hard-faced makes this desirable.

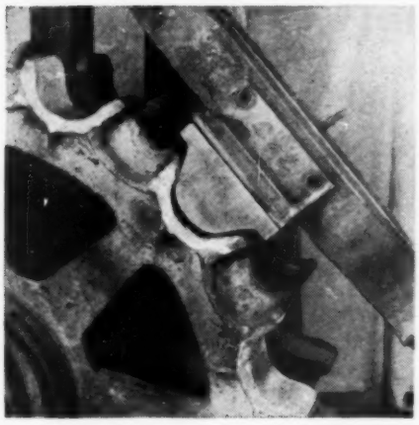


WRITE FOR LITERATURE

Let us send you Catalog 76, containing full information on the complete line of Colmonoy hard-facing alloys, testing from 15 to 68 Rockwell C. Typical applications are illustrated. We also furnish Engineering Data Sheets that are released from time to time giving technical information of interest to those who must find the answer to problems of extreme wear and corrosion.



One type of jig used for rebuilding tractor sprockets. Front sprocket is to be rebuilt. Sprocket in rear is new. The die suspended on crossarm has the reverse contour of new tooth.



Sufficient Colmonoy No. 6 is welded to the tooth and is brought to the "plastic range." The die is brought down, with the new sprocket as a stop, forming the Colmonoy to the exact contour.

The excess Colmonoy extruded over the sides is again brought to the "plastic range" and wiped off with a cast iron rod. This procedure is repeated on each tooth until the sprocket is completed.

WALL COLMONOY CORPORATION

7TH FLOOR FISHER BLDG., DETROIT 2, MICH.

"ON THE LEVEES" it's 81% Euclid

Down in the levee country where soft, wet borrow pits usually necessitate dragline loading of hauling units . . . where difficult haul roads and soft fills make the use of ordinary hauling units impractical . . . Bottom-Dump Euclids are the outstanding choice of leading contractors.

Of the total 30,369,500 cu. yds. let on contract * in 1945, 81% is yardage hauled by Euclids. On many of the large contracts Euclid hauling equipment is being used exclusively.

This unusual record is the result of the fine performance of Euclids on levee work for many years. Their large capacity, flotation and tractive power, and ease of handling are some of the reasons why Euclids have consistently hauled more levee dirt than other makes and types of earth moving equipment.

See your Euclid distributor for complete information and specifications on the Bottom-Dump or Rear-Dump Euclid models best suited to your particular hauling needs.

*Memphis, Vicksburg and New Orleans districts.

EUCLID EARTH MOVERS

REAR-DUMP EUCLIDS
Capacities of 15 to 22 tons — 9.2 to 20.7 cu. yds., struck . . . loaded top speeds of 22 to 35 m.p.h. . . . powered by 150 to 275 h.p. Diesel engines.

BOTTOM-DUMP EUCLIDS
Capacities of 20 to 32 tons — 13 to 42.9 cu. yds., struck . . . loaded speeds from 26 to 34.4 m.p.h. . . . powered by 150 to 275 h.p. Diesel engines.

EUCLID LOADER
Fast loading of hauling equipment . . . makes shallow cuts to 9'6" wide . . . maximum cutting depth of 24" . . . the 54" belt is powered by 150 h.p. engine.

The EUCLID ROAD MACHINERY Co.
CLEVELAND 17, OHIO

"MISSISSIPPI WAGONS GIVE US The Cheapest Yard

Mississippi Wagons loading, hauling and dumping on the Mississippi River levee operations of T. H. Stout Construction Company

HEMMING in Ol' Man River is a tough, never-ending job that goes on in all seasons and weather. Levee construction calls for tough, never-quitting hauling equipment... if work is to go forward on schedule and at a profit.

The ability of Mississippi Wagons to keep going in rough going is well known along the levees. But the full degree of their freedom from expensive repairs, and consequent ability to haul at rock-bottom costs-per-yard, is best revealed by the cost records of owners—such as the T. H. Stout Construction Company, of Cleveland, Miss.

"Worst Conditions in 25 Years"

The T. H. Stout Construction Company purchased seven Mississippi Wagons in September, 1944, to handle contracts for levee work at points south of Greenville, Miss.

After encountering normal conditions during the first construction season, the company resumed work in June, 1945, in ground still waterlogged from floods. Heavy intermittent rains kept the ground from drying out during the entire remainder of the year. "Operating conditions," says T. H. Stout, owner of the company, "were the worst that have been known along the Mississippi River in any construction season in the last 25 years."

In 15 months, nevertheless, the seven Mississippi Wagons hauled a total of 724,000 yards of earth to the levee, for an average of 103,428 yards per unit. Some of the dirt was carried from considerable distances, and much of it was hauled to the top of the embankment, as the company's contracts included heightening the levee by five feet.

1 1/6¢ Per Yard For Repair Parts

During these 15 months the Stout company used a total of $8,421.56 worth of repair parts on its Mississippi Wagons — an average of $1,203.08* per unit. Figured on a yardage

*Broken down as follows: Motor, $277.95; fuel pump, $79.96; master clutch, $32.64; transmission, $282.35; rear end, $206.66; miscellaneous, $126.66; trailer, $198.86.

For further information on Mississippi Wagons, consult your nearest distributor or write direct.

M-R-S MANUFACTURING COMPANY
JACKSON, MISSISSIPPI, U. S. A.

Yardage We've Ever Hauled!"

—T. H. STOUT, Mississippi Levee Contractor

basis, the repair parts cost came to just one and one-sixth cents per yard of dirt hauled.

"For Mississippi River levee operations, and particularly under last season's conditions, this is an almost unbelievably low figure," declares Mr. Stout. "And it would undoubtedly have been even lower, had we not been forced to use our head mechanic as job superintendent, making it impossible for him to properly supervise the maintenance of our equipment."

Easy, Efficient Operation

"In addition to the low maintenance cost of our Mississippi Wagons," says Mr. Stout, "we are highly pleased with their ease of operation, operator comfort, superior flotation on soft ground, accessibility for making repairs, and short turning radius.

"With their all-round operating economy, I am convinced that Mississippi Wagons give us the cheapest yardage we've ever hauled. And I am also convinced that any hauling equipment that could operate successfully and economically for us during the past season, can do likewise on any construction job anywhere!"

Only MISSISSIPPI WAGONS Give You Both These Important Advantages:

1. FOUR-AXLE CONSTRUCTION

- Puts more tire surface on the ground, providing maximum flotation over soft earth on construction work.
- Enables you to haul payloads of up to 27,000 pounds on highways without exceeding state axle-loading limits.
- Relieves the tractor of all trailer weight (except when needed for traction), thus prolonging tractor life and cutting repairs to a minimum.

2. HYDRAULIC WEIGHT TRANSFER

The simple hydraulic cylinder transfers weight from trailer to tractor when extra traction is needed. This patented feature is found exclusively on Mississippi Wagons. It makes possible their four-axle design, which gives you both construction and over-the-highway equipment in a single unit . . . for a single investment.

★ MISSISSIPPI WAGON

★ *The World's Most Modern Hauling Unit*

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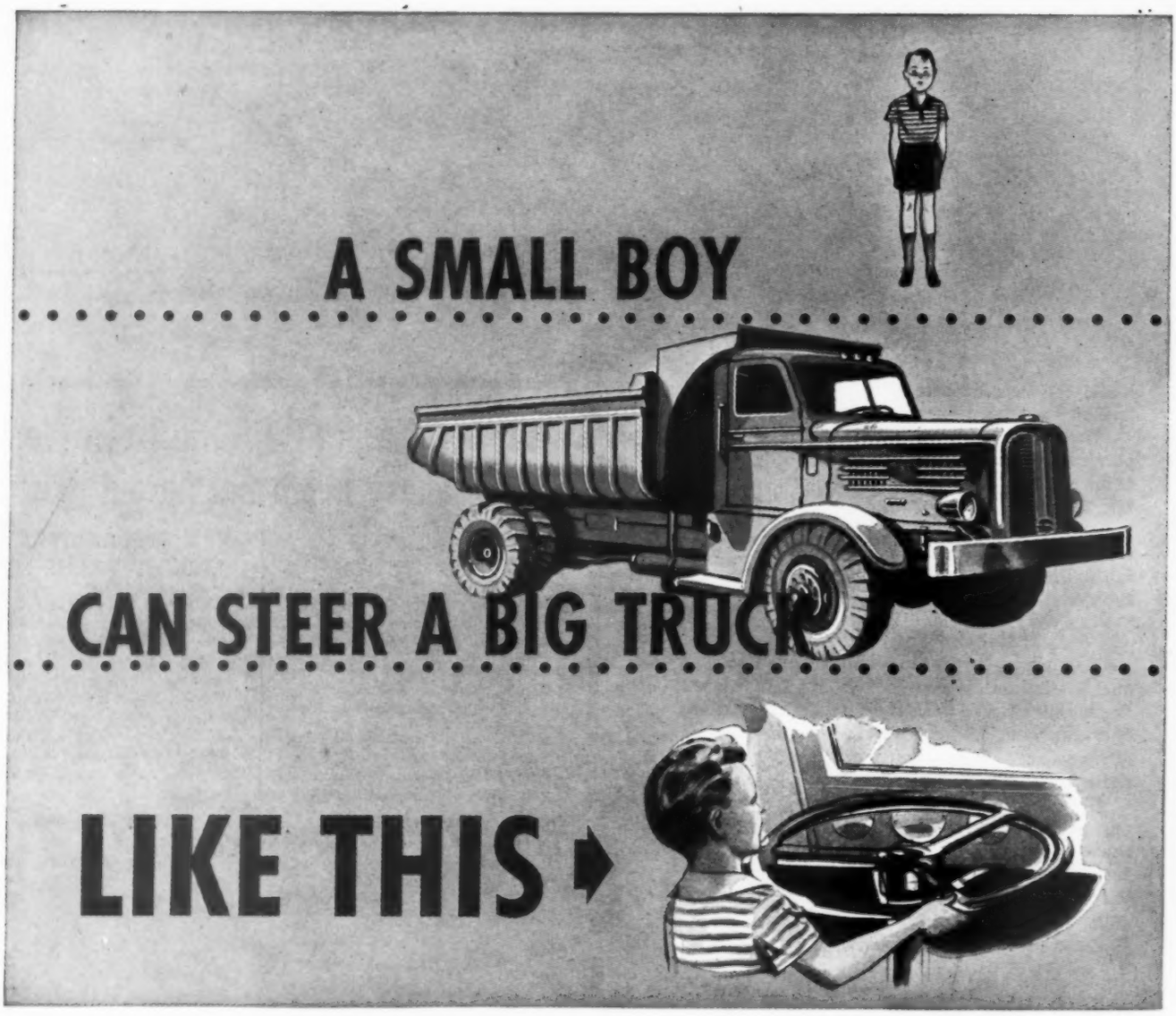
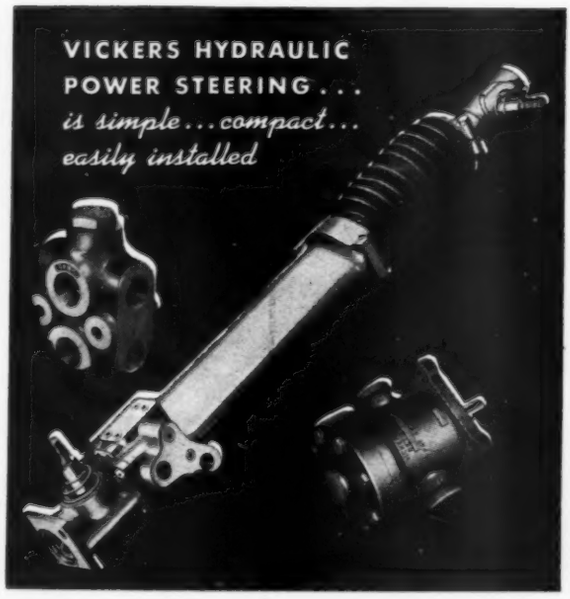


with VICKERS Hydraulic POWER STEERING

We don't expect a small boy to drive a big truck, but his strength is many times equal to the steering effort required if the truck has Vickers Hydraulic Power Steering. The steering wheel turns with effortless ease, and the front wheels always follow *exactly*.

Moreover, no matter how rough the ground, no road shock can get to the driver. The steering wheel cannot spin, or jerk—the vehicle can be driven over the curb or through sand with no "fight" from the wheel. A flat tire will not cause swerving. The driver is relieved of the most fatiguing part of his job—enabling him to work faster and longer with greater safety.

Vickers Hydraulic Power Steering is simple, compact, easy to apply to existing chassis designs. It has automatic protection against abuse and excessive steering reaction forces. Lubrication is automatic. Fifteen years of successful operating experience on trucks, buses, road machinery, etc. have proved the value of Vickers Hydraulic Power Steering. Write for Bulletin 44-30.



VICKERS *Incorporated*

1432 OAKMAN BLVD. • DETROIT 32, MICHIGAN

Application Engineering Offices: CHICAGO • CINCINNATI • CLEVELAND • DETROIT
LOS ANGELES • NEWARK • PHILADELPHIA • ROCHESTER • ROCKFORD
TULSA • WORCESTER

WHEN YOU'RE BACKING IN BATCH TRUCKS THAT *EXTRA* FOOT *HERE* COUNTS A LOT

● The skip of the Koehring 34-E *Twinbatch* Paver is 10 feet wide, approximately a foot wider than other paver skips. When you're backing batch trucks into a paver skip, fast, that extra foot means a lot. You're in and out just a little faster. And "just a litt'e faster" means big money on a paving job.

For the Koehring *Twinbatch*, that big 10-foot skip is just right because the *Twinbatch* is a big, Heavy-Duty paver, almost 12 feet wide, weighing 60,400 pounds, and every pound working weight.

Double, continuous, self-equalizing cables raise the skip in 8 seconds. Each cable alone is strong enough to raise the loaded skip. Replaceable liners keep abrasive wear away from the skip throat. Welded lip, with extra tire tread plates, acts as a ramp, makes it easier for trucks to get into skip on a rough grade.

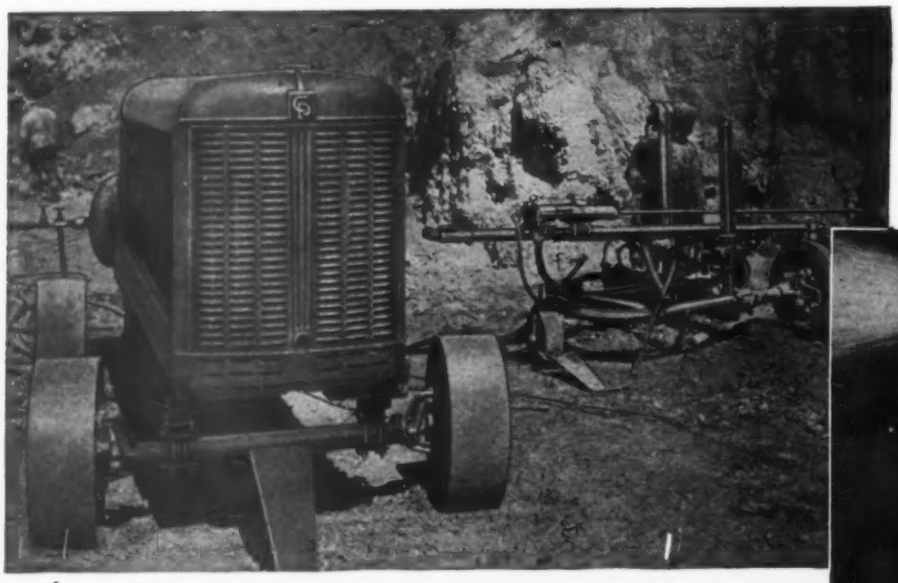
KOEHRING 34-E *twinbatch* PAVER
TWO COMPARTMENT DRUM

KOEHRING COMPANY, *Milwaukee 10, Wis.*

KOEHRING HEAVY DUTY

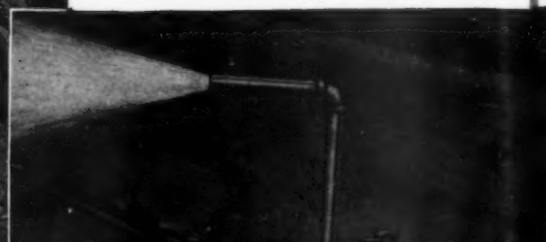
HEAVY-DUTY CONSTRUCTION EQUIPMENT

CP EQUIPMENT... helps keep



↑ **FUEL-SAVING** CP Two-Stage, Air-Cooled, Portable Compressors produce 15% to 35% more air per gallon of fuel. The CP gradual speed regulator varies engine speed with air demand, resulting in reduced fuel consumption and less wear. Other refinements include pressure lubrication, Simplate valves, self-adjusting clutch. CP Portables are available in gasoline-powered models of 60, 105, 160, 210 and 315 c.f.m. and Diesel-powered sizes of 105, 160, 210, 315 and 500 c.f.m.

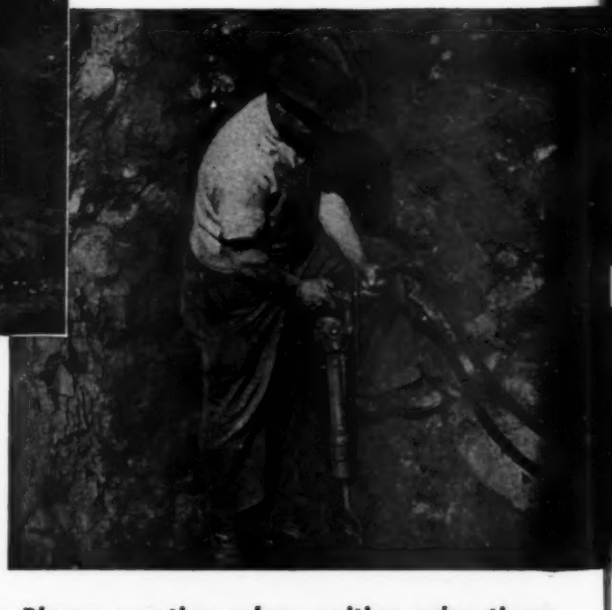
RUGGED, HIGH-LIFT CP-7 Portable Sludge Pump operates on the ejector principle. It handles up to 15% solids, without excessive wear or frequent ↓ replacement of parts when water contains sand or other matter.



↑ **HANDY** CP Backfield Tampers quickly pay their way by saving the cost of handling surplus excavated materials, especially in trench work. Advantages include firmer and more uniform tamping, easy control of speed and impact — all available in four different CP models.

↑ **REMOVAL OR APPLICATION** of nuts and bolts by CP 365-RP (impact type) Wrenches is performed in a fraction of the time required by hand wrenches. Capacity of the 365-RP, 1¼" bolt size. Five other models handle bolts, nuts, from ⅜" to 1¾" bolt size.

LIGHT in weight, fast, and easy to handle, Chicago Pneumatic Clay Diggers are ideal for digging in clay, shale, etc. For general digging in soft to medium hard clay the lighter CP-3 is recommended. For digging ↓ in hard clay, shale, etc., there's nothing faster or better than the CP-5.



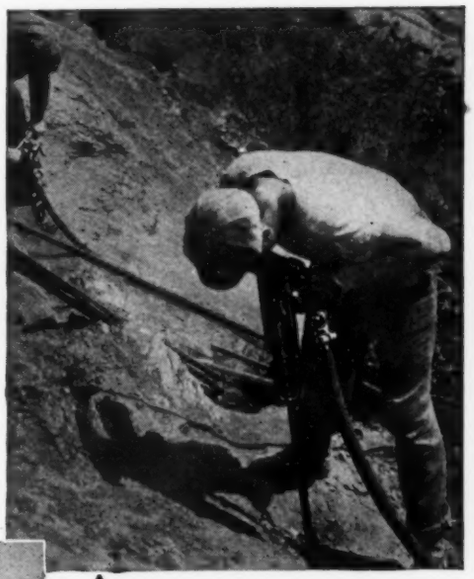
jobs moving on schedule!

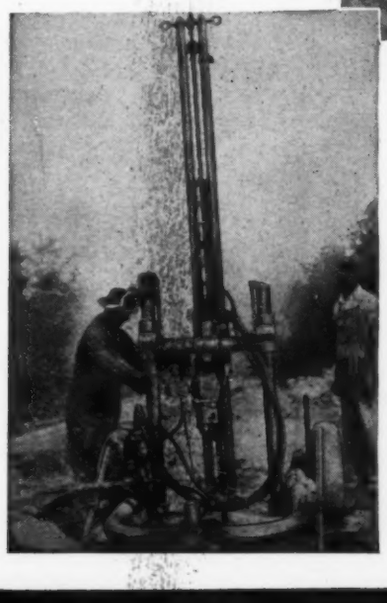
Contractors faced with a multitude of projects demanding early completion are quality-conscious buyers of equipment — especially pneumatic tools, air compressors, rock drills, sinker drills, etc.

Today, as for more than 45 years — CP equipment stands out for dependable performance and stands up against wear. If you want to know more about equipment that will keep your jobs moving on schedule, send for CP Catalog 600, "Construction Equipment."

SPEEDING demolition work of all kinds, CP Demolition Tools operate with smooth efficiency and minimum kick-back. They are time and money savers for contractors. Sizes range from 25 to 82 lbs.

ALL PURPOSE CP Rotary Grinder, equipped with detachable wire brush is ideal for fast surface cleaning on construction jobs. Light weight and true balance make handling easier for the operator.





PACE-SETTING CP-42 Sinker Drill has penetrating power, excellent hole-cleaning, strong rotation. This fast 56-pound drill has a sturdy retainer spring encircling the front end, for longer life and lower maintenance. Ideal for general excavation, shaft sinking, quarrying, etc., CP makes sinker drills for every purpose, from the light 28-pound CP-22 Sinker, to the 119-pound, CP-60 heavy-duty spring handle model.

THERE ARE many jobs that call for the light weight G-200 R Wagon Drill to provide one-man operation and faster drilling with the more powerful CP Drifter Drills. G-200 R is readily moved about, easily accommodates 6 foot steel changes; and handles up to 24-foot steels.

★★★★★★★★★
PNEUMATIC TOOLS
ELECTRIC TOOLS
HYDRAULIC TOOLS
ROCK DRILLS

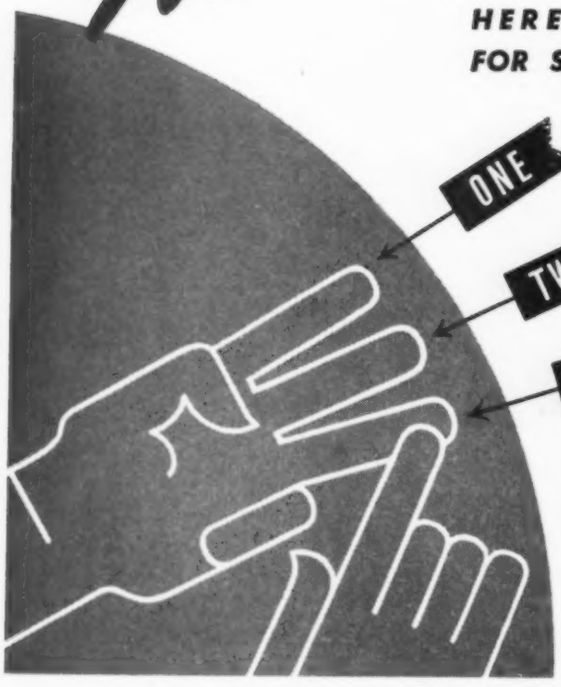
CHICAGO PNEUMATIC
TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

CECO MAKES ROAD BUILDING

As Easy as 1-2-3

HERE IS A 3-POINT PROGRAM FOR SURER ROAD BUILDING PROFITS



You can bid to get the job and make money on it too when Ceco serves you because Ceco supplies you with accurate pre-bidding data.

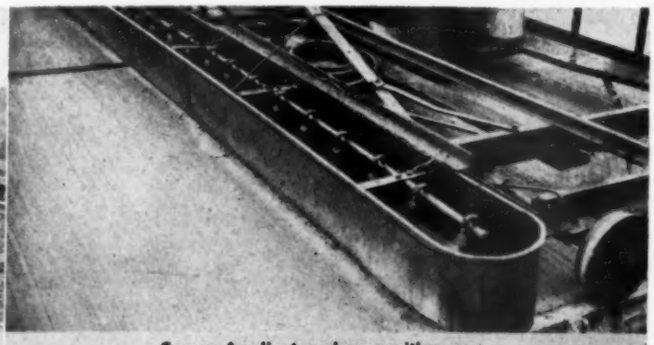
You can forget detail work when you deal with Ceco. They supply you with blue prints on re-inforcing and other materials, making your construction job easier.

Ceco streamlines road building for you. In one complete order you can specify everything you need. Ceco gets materials to you where you want them—on time.

CECO ENGINEERING + CONSTRUCTION KNOW-HOW HELPS SOLVE YOUR ROAD BUILDING PROBLEM

Ceco offers you more than precision road building materials, for Ceco engineers have years of practical construction experience behind them. All that wealth of *construction* know-how is yours. Call any one of the 23 offices strategically located coast to coast. Yes, remember Ceco for engineering skill and the finest in construction products.

Welded Fabric, electrically welded at intersections, makes ideal reinforcing. .



Cecure Applicator gives positive, even application of Cecure compound.

Typical Ceco Highway Products

- Welded Wire Fabric
- Reinforcing Steel
- Dowel Bar Supports and Sockets
- Metal Center Strips
- Load Transfer Devices
- Stake Pins
- Expansion Joints
- Cecure Curing Compound and Applicators
- Joint Sealing Compound
- Sub-grade Paper

CECO STEEL PRODUCTS CORPORATION
HIGHWAY PRODUCTS DIVISION
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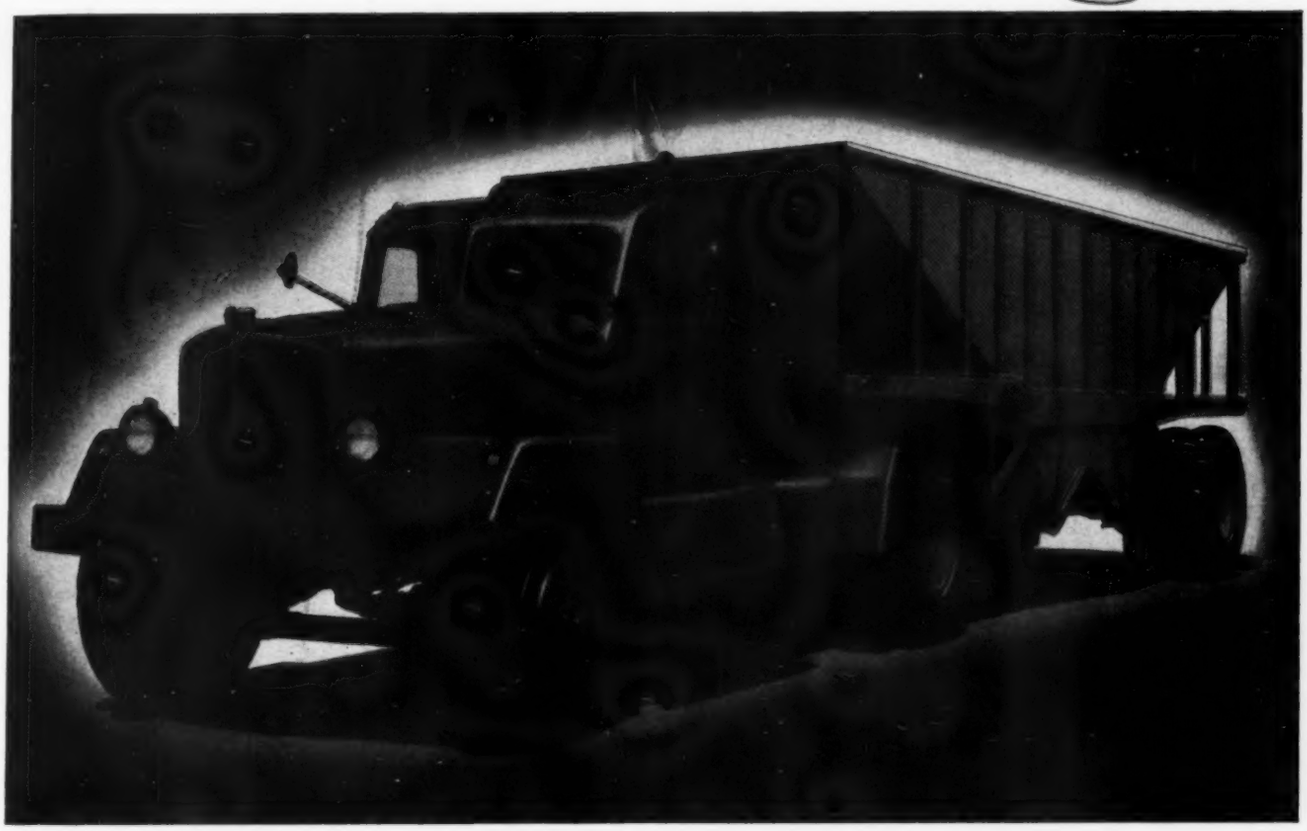
In construction products **CECO ENGINEERING** *makes the big difference*

"*That* hill? Man, this big, new Ward LaFrance flattens *all* hills!"



Tug Hill, Howlett Hill, Long Hill, *any* hill — you can depend on the big, new Ward LaFrance heavy duty trucks. They're rugged, reliable and packed with power.

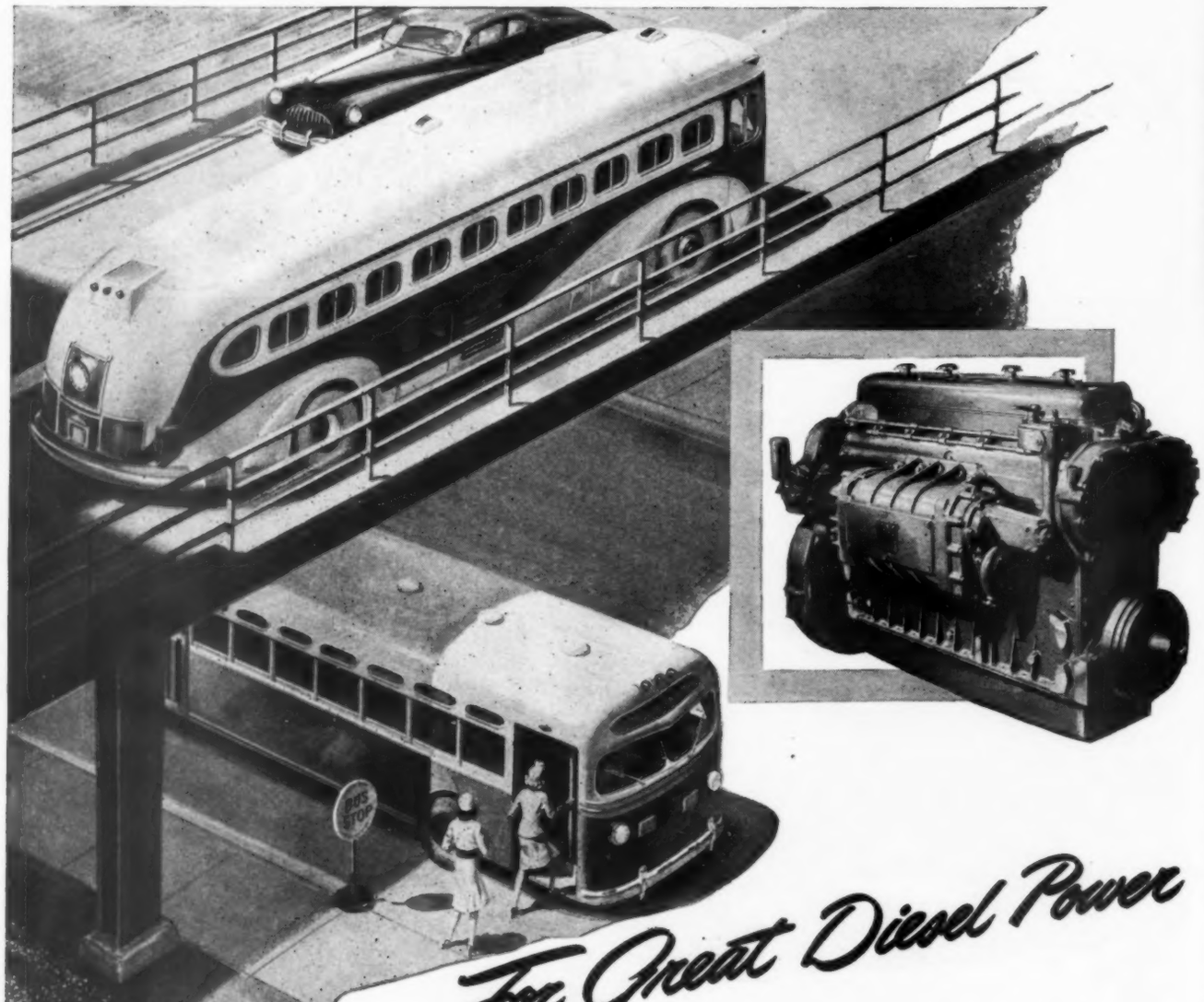
For economical hauling your best bet is a Ward LaFrance. Winter or Summer — 30° below or 110° in the shade — your Ward LaFrance will give you consistent performance day after day.

The new Ward LaFrance trucks and over-the-road tractors, both gasoline and Diesel, are designed, engineered and manufactured to meet all hauling requirements with maximum efficiency. Built to take a beating and stay on the job, these dependable trucks are setting new records for stamina and reliability.

For complete information about these trucks that are setting new standards of performance, see your local dealer. If no dealer has yet been appointed in your community, write direct to factory.

WARD MOTOR TRUCKS LA FRANCE

WARD LA FRANCE TRUCK DIVISION
Great American Industries, Inc.
ELMIRA, NEW YORK



For Great Diesel Power

—see what bus operators are doing

LITERALLY thousands of GM Diesel-powered buses are on America's streets and highways. Many have traveled more than a million miles and are still going strong. They're pulling upgrade smoother, making better time and getting over 50% more miles per gallon, using low-cost fuel.

Because they're powerful and compact, these engines have made it possible for buses to take advantage of all the economy and dependability of Diesel power.

And they can bring these advantages to countless users of power who haven't been able to consider Diesel before.

Whatever needs for power you may have in road-making machinery, cranes, shovels or any other construction material — look to GM Diesels.

Features of GM Diesels Important to Every User of Power

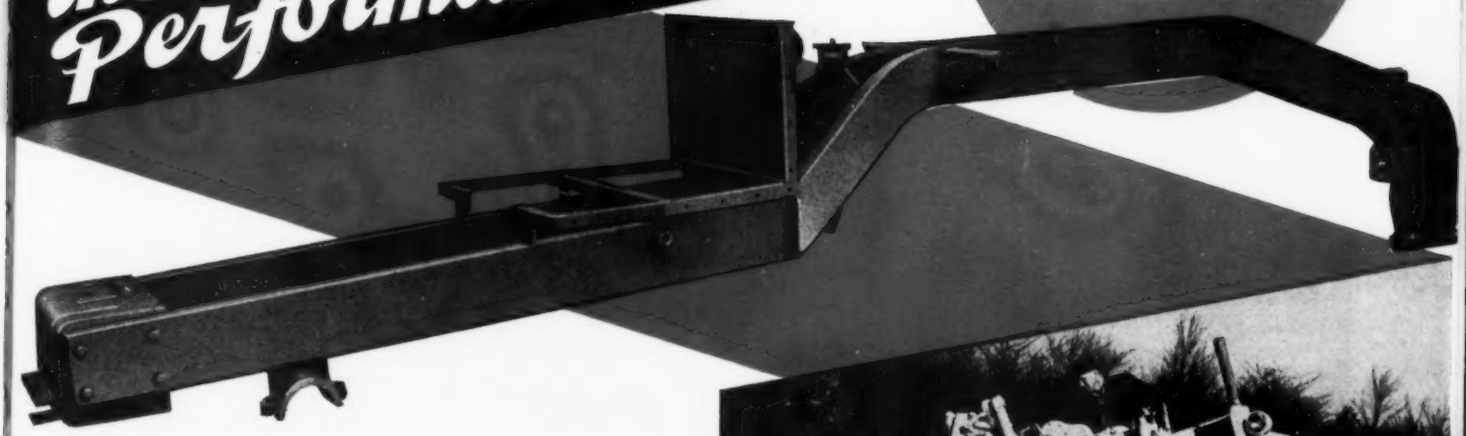
- ***QUICK TO START*** on their own fuel
- ***LOW COST***—run on common fuel oil
- ***EASY TO MAINTAIN***—clean design plus accessibility
- ***LESS FIRE HAZARD***—no volatile explosive fuel
- ***COMPACT***—readily adaptable to any installation
- ***SMOOTH OPERATION***—rotating and reciprocating forces completely balanced
- ***QUICK ACCELERATION***—2-cycle principle produces power with every downward piston stroke

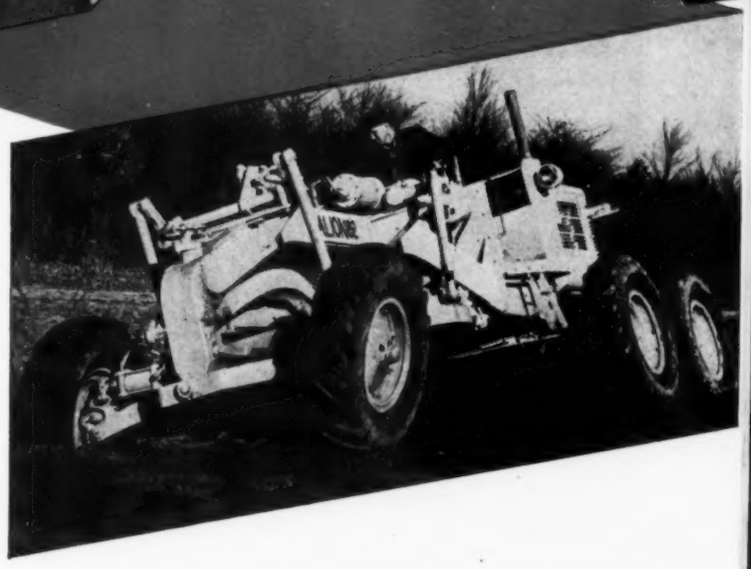
GM
GENERAL MOTORS
DIESEL POWER

DETROIT DIESEL ENGINE DIVISION
DETROIT 23, MICH. • { SINGLE ENGINES . . Up to 200 H.P. / MULTIPLE UNITS . . Up to 800 H.P.
GENERAL MOTORS

THE STRONGER THE BACKBONE the Better the Performance

Welded
HEAVY BOX TYPE SECTION FOR EXTRA
STRENGTH





One of the primary reasons why results at the blade are so superior with the Galion 102 Motor Grader is because of the *solid foundation* for blade operations which the welded BOX TYPE FRAME offers. The Galion 102 frame is designed to give weight and strength where it is most needed.

In our many years' experience, actual service records have proved that the welded box type frame is strong, rigid, and practical—and in the Galion 102 we've made it rugged enough to stand up under any blading job you may require of it.

It's just one of the MANY reasons why the Galion 102 accomplishes with such ease the tough jobs you demand of motor graders today. Catalog No. 290 dsecribes them all—write for a copy today.

A "BACKBONE" for Tough Jobs

The Galion Welded Box Type Frame has all those features which are essential to top grader performance, such as overall rigidity, ruggedness, and strength—reinforced at critical points—to withstand the severe stresses built up under tremendous blade pressures, tractive power, steep angles of operation, etc., without impairment to the proper shape and alignment of the frame. The front end of frame is supported by an extra-heavy frame head block casting which is securely welded to the frame members, and provides a rugged anchor for the drawbars. Ask your nearest Galion Distributor to show you what the Galion 102 can do.

The GALION IRON WORKS & MANUFACTURING COMPANY

General and Export Sales Offices

Galion, Ohio, U. S. A.

GALION IRON WORKS

GRADERS · ROLLERS

Gulf Products selected by Contractor on Mississippi's largest levee project

Gulf Quality Lubricants and Fuels help Atlas Construction Company get maximum job efficiency under tough operating conditions

Moving a total of 10,350,000 yards of earth—under difficult operating conditions and against a rigid time schedule—is no small undertaking. It is the kind of job on which the contractor is not likely to take chances with his equipment. He wants proper lubrication and efficient fuels to insure top performance and prevent costly delays caused by breakdowns.

That is why Atlas selected Gulf quality lubricants and fuels for their two Mississippi Levee projects, which they completed well ahead of schedule. Both were a grueling test for men and equipment. On one of the jobs, at Bougere, upwards of 8,500,000 yards were moved—the largest single levee project ever undertaken on the Mississippi River.

The Atlas Construction Company, and many other leading contractors, have formed the habit of using Gulf quality lubricants and fuels as basic profit insurance. They know that Gulf products help speed up the job—keep operating costs at rock-bottom levels.

Call in a Gulf Service Engineer before you start your next job—he will help you complete it more quickly and at a larger profit. Write, wire, or phone your nearest Gulf office today.

GULF

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Division Sales Offices:

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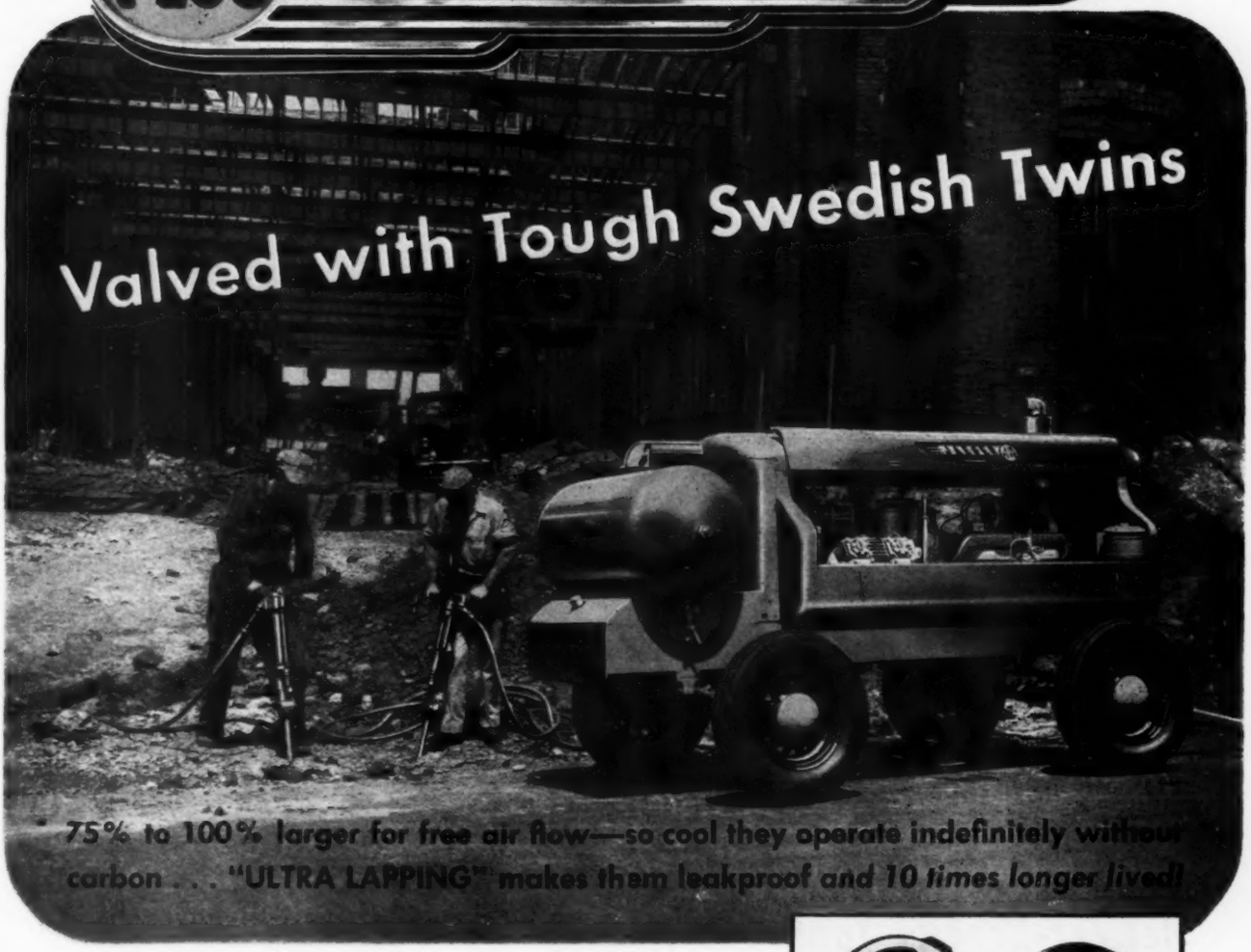
AIR PLUS JAEGER COMPRESSOR


Valved with Tough Swedish Twins
75% to 100% larger for free air flow—so cool they operate indefinitely without carbon . . . "ULTRA LAPPING" makes them leakproof and 10 times longer lived!

The heart of every "AIR PLUS" Compressor is a set of Swedish Twins . . . steel chosen for its toughness and carefully hardened . . . "ultra lapped" by Jaeger's exclusive process to form perfect seating, leakproof valves and make them 10 times longer lived . . . doubled in size to let the air flow freely, eliminating heat, carbon and power-wasting back pressure, and to operate with lower lift and a resulting minimum of wear. Send for Catalog JC-5. It shows you why compressor users are demanding "AIR PLUS."

THE JAEGER MACHINE CO., Columbus 16, Ohio

REGIONAL OFFICES: 8 E. 48th St. NEW YORK 17, N. Y. — 226 N. LaSalle St. CHICAGO 1, ILL. — 235-38 Martin Bldg. BIRMINGHAM 1, ALA.

JAEGER *Engineered* EQUIPMENT

JAEGER-LAKEWOOD SPREADERS, FINISHERS AND BITUMINOUS PAVERS, FORMS, FORM TAMPERS—"DUAL-MIX" TRUCK MIXERS, AGITATORS—JAEGER HOISTING ENGINES, TOWERS

HOT OIL FAST!
..with Less FUEL..WATER..WORK

Handle that road oiling contract more profitably with a Cleaver-Brooks Tank Car Heater

The quicker you get the oil or asphalt in the tank car on the siding up to application temperature and flowing into the distributors—the faster your road crews can get going and finish the job.

With a Cleaver-Brooks Tank Car Heater you can have hot, dry steam flowing to car coils from a cold start in 20 minutes or less. And you can keep going all day with the least work and bother because a Cleaver-Brooks Tank Car Heater requires less fuel and water.

Perfected — highly efficient — you can tow it with car or truck to tank car siding, construction site, material yard or other locations where you need steam.

The famous Cleaver-Brooks four-pass fuel travel means low fuel consumption; the turbine type condensate return system cuts water loss — every drop of condensate goes back to the heater under pressure.

Built for full capacity — full time work — Cleaver-Brooks Tank Car Heaters will give you the most in production hours on the job. Write for bulletins and complete information.

CLEAVER-BROOKS COMPANY
5106 North 33rd Street, Milwaukee 9, Wisconsin

Write On Your Business Letterhead . . .
For the Bituminous — mix Calculator — a ready reference slide rule showing weight of mix needed in lbs. and tons in relation to width and depth of area to be covered.

Cleaver-Brooks

PIONEERS AND ORIGINATORS OF

TANK CAR HEATERS . . . BITUMINOUS BOOSTERS . . . AUTOMATIC STEAM-PLANTS

IN MUNICIPAL SERVICE ONE FWD TRUCK DOES *Many* JOBS

FOUR-WHEEL-DRIVE

A "Plus" that Pays in Many Ways!

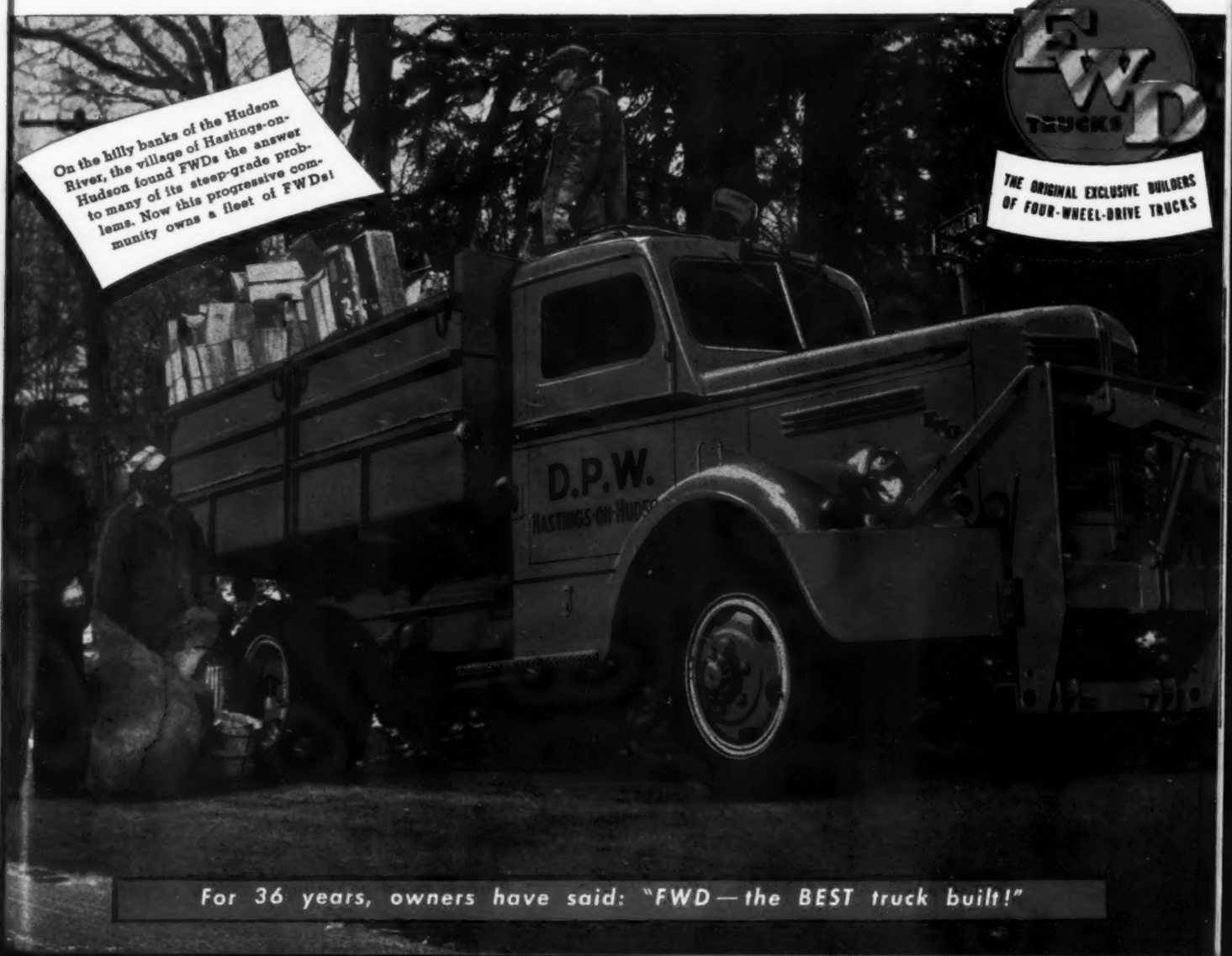
There are scores of jobs an FWD truck can do in municipal service . . . new road construction, road maintenance, land clearing, refuse disposal work, heavy hauling, snow clearing, and many other heavy-duty jobs. These rugged, dependable, all-weather, all-season, all-purpose trucks give the taxpayers a big "money's worth" on their investment.

The true FWD four-wheel-drive principle at its highest development, with center differential . . . driving-power and traction on all wheels . . . and other important advantages are reasons why FWDs are the first choice among municipalities who know FWD performance-proved features.

See your FWD dealer, or write for information on FWD trucks now available.

THE FOUR WHEEL DRIVE AUTO COMPANY, Clintonville, Wisconsin U.S.A.

Canadian Factory: KITCHENER, ONTARIO


On the hilly banks of the Hudson River, the village of Hastings-on-Hudson found FWDs the answer to many of its steep-grade problems. Now this progressive community owns a fleet of FWDs!
FWD TRUCKS
THE ORIGINAL EXCLUSIVE BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS
D.P.W.
HASTINGS-ON-HUDSON

For 36 years, owners have said: "FWD — the BEST truck built!"

Resists Abuse Better...

UPSON-WALTON IWRC* WIRE ROPE

FOR winch lines on trucks and tractors . . . for hoist lines on power shovels and in-haul ropes on draglines . . . for hot ladle cranes in steel mills and foundries . . . for cable scrapers, stump pulling ropes, rotary drilling lines for oil wells, mining machines—industry after industry operates under conditions which require IWRC (*Independent Wire Rope Center) construction to do the best job.

IWRC construction resists crushing better where ropes crosswind on drums, retains its circular cross section when bent around small sheaves and drums under extra heavy loads. It resists stretching, resists heat and increases the ultimate strength of the rope itself.

IWRC construction is available in every type of wire rope made by Upson-Walton.

For best performance, select the U-W rope best suited to your needs and specify *IWRC, Perfection Grade, Layrite Preformed.*

U-W

Established 1871

All Upson-Walton Products Available Through Your Local Upson-Walton Distributor

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Manufacturers of Wire Rope, Wire Rope Fittings, Tackle Blocks

MAIN OFFICES AND FACTORY: CLEVELAND 13, OHIO

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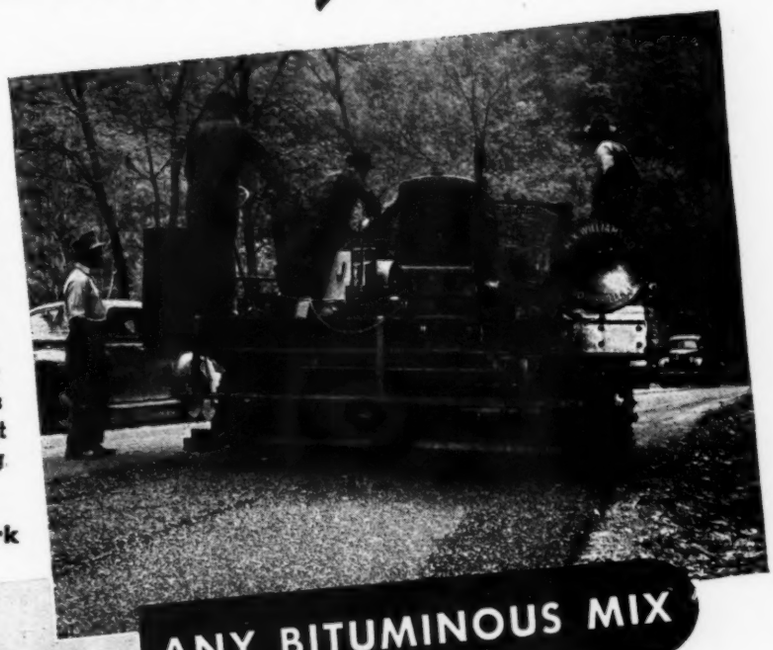
THE FOOTE COMPANY, INC.
1936 State Street Nunda, New York



ANY BITUMINOUS MIX

Hot or cold, stiff mixes or light, Adnun Black Top Pavers handle any bituminous material—put down black top fast and accurately to any specifications required. Continuous Course Correction and crowding-compacting cutter bar give smooth finished paving, tight joints and uniform compaction.

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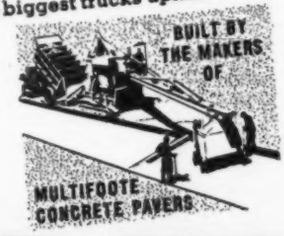
Spreading coarse, loosely-held materials with the Adnun saves time and labor on any road job. Adnuns are built for tough work . . . high structural strength throughout, with plenty of power to handle the biggest trucks uphill or in rough going.



SOIL CEMENT AND STABILIZERS

Get the right compaction, width and course thickness as soil cement is laid with your Adnun Pavers. One machine does the job at a single pass per course to give you better roads at lower costs per mile.

ADNUN
TRADE MARK REGISTERED
BLACK TOP PAVER

Four Army-Navy Awards for production excellence.

REPLACE DANGER with SAFETY

DIETZ LANTERNS

Place DIETZ LANTERNS on guard for every emergency use. They faithfully guide the way, night after night, without diminishment of light.

DIETZ LANTERNS will not fail or falter as long as a drop of oil remains to burn. Many models will give light and safety for an entire weekend with plenty of kerosene left to spare.

Keep your DIETZ LANTERNS in good service—ready for use the moment needed.

Do not gamble with light and safety. DIETZ LANTERNS and DIETZ ROAD TORCHES give dependable light with safety—for over a century.

1840 R.E. DIETZ COMPANY NEW YORK 1946

Output Distributed Through the Jobbing Trade Exclusively

Why "Know How" Contractors *Prefer Rugged* SAUERMAN LONG RANGE MACHINES

Picture shows Sauerman Power Scraper of smallest size cleaning out a pond and at the same time creating valuable real estate by spreading excavated material over marshy area along one side of pond.

1 Operated by ONE MAN
2 Digs, Hauls, Dumps in ONE Operation
3 Low initial and upkeep costs
4 Easily maintained

Sauerman Scraper and Cableway machines are made in all sizes to take care of all jobs from smallest to largest. Electric, gasoline or Diesel power.

Write or wire for complete Sauerman Catalog. Let us advise you on your specific jobs.

SAUERMAN BROS., INC.

588 S. Clinton St. *Power Scrapers & Cableways* SINCE 1909 Chicago 7, Ill.

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quickly laid
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immediate use
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give long service

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The Advanced All-Weather Aid in Building Better Roads

Better WEED CONTROL *this Season* WITH 2-4D

Tested and approved by leading agricultural colleges.

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2-4D WEED KILLER WILL DO THE JOB!

- COMPLETELY WATER SOLUBLE
- WILL NOT DETERIORATE

Packaged in 8-ounce, quarts, gallons, 5-gallon and 50-gallon containers

Write or wire dept. (5) now for quantity discounts

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Agricultural Chemicals and Hormones
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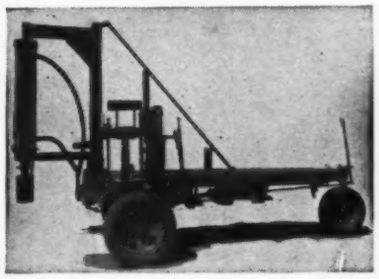

Cuts concrete and cuts labor costs to 2½c per square yard. Applicable to floor work and different types of inside horizontal work.

Very efficient in maintenance work of highways.

Boom folds down and readily trailed by any light truck. Make your compressor treble its output by hooking it to this machine.

Rapid Pavement Breaker Co.
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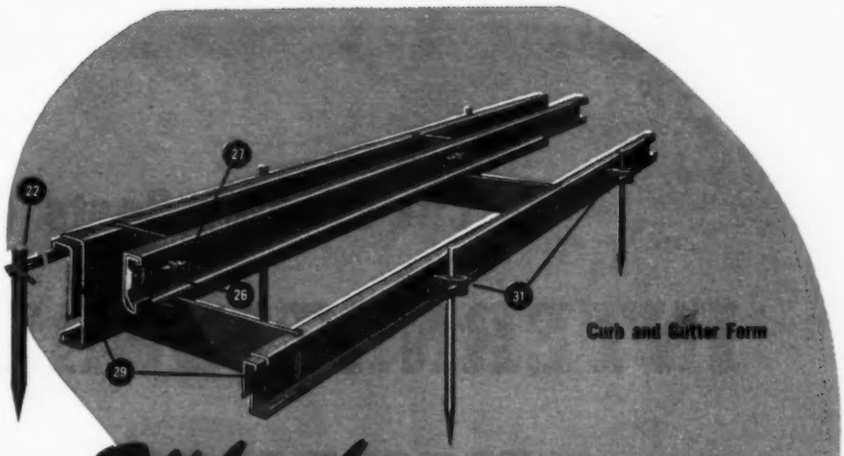
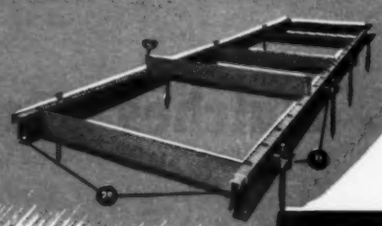


Curb and Gutter Form

Which HELTZEL FORM FEATURE DO YOU PREFER?

Sidewalk Form



22 Adjustable Lateral Braces and Anchor Stakes for use on rigid or flexible radius forms hold top of form in positive alignment.

26 No loose parts or clamps. Secure the face form to the division plate, slide the locks home and start to pour.

27 Face forms are quickly removed after the concrete has taken its initial set, by disengaging the lock. Skeleton division plates are provided with the same arrangement.

29 A sleeve welded on one end of the rail over which the adjoining rail fits, makes an absolutely tight even joint.

31 Round stakes securely locked to the form by the wedge key permit the form to be suspended entirely independent of the subgrade. Indispensable when subgrade conditions are not uniform.

You buy Heltzel Steel Forms once. They stay in service for 20 years or more and each job you set is as uniform as the ones before. The low cost of equipment per year of service plus benefits of faster work with the use of steel forms, nets substantial savings and more business.

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BUILDS IT BETTER

- BINS, Portable and Stationary
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C-36 BULK CEMENT PLANTS ☐ E-41 RECIRCULATING TANK ☐

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(Type of Construction usually engaged in)

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WARREN, OHIO · U. S. A.

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Snow Plow and Ice Removal BLADES
Proved record of superior performance. Made of specially developed steel to withstand severe service conditions.
FOR ALL TYPES AND MODELS OF SNOW PLOWS
Various widths, lengths, thicknesses--flat or curved--standard or special--punched ready to fit your machine.
SHUNK SAW-TOOTH ICE BLADE
Amazingly effective. Thoroughly breaks up and removes heavy, slippery ice and snow formations. Replaces all types of snow plow blades or maintenance units. Write for Bulletin and name of nearest Distributor.

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INTERNATIONAL TRUCK EXCHANGE UNITS

Clutches • Brake Shoes • Crankshafts

• These and many other International Truck Exchange Units are reconditioned by factory methods so expertly that they are practically the same as new.

They cost less, but deliver new unit service.

They save time. The old unit is removed. The Exchange Unit is installed.

They are available from International Branches and International Dealers everywhere—installed by International-trained shop mechanics. Ask for International Truck Exchange Units.

Also available from your International Truck Branch or Dealer

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180 North Michigan Avenue **Chicago 1, Illinois**

Tune in "Harvest of Stars" Sunday, 2 p.m. Eastern Daylight Time. NBC Network

INTERNATIONAL *Trucks*

USERS WRITE THE *best ads*

"This machine takes care completely of 135 miles of rolling country dirt and gravel road. On job almost every day. Builds, modernizes, maintains, repairs roads and ditches. Plows snow in winter. Machine is a watchword for dependability. Farmers really like it. Any time you can't work this No. 12, the ground isn't fit to be worked. The controls really give the blade adjustments I want — and immediately. Purchased in 1938, this machine will last at least another 7 years. ***In our opinion, there is no other outfit built to equal this machine in dependability, capacity and all-around economy for general road work and maintenance.***"

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ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

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ATLAS DURAPLASTIC

TRADE MARK REG. U. A. C. CO.

THE AIR-ENTRAINING PORTLAND CEMENT

That Makes Better Concrete at No Extra Cost

1. Complies with ASTM specifications: Provides the proper amount of entrained air by intergrinding with the cement the precise amount of air-entraining material needed for satisfactory field performance.

2. No extra cost: Sells at the same price as regular cement. Produces concrete that spreads, screeds and finishes more easily. Calls for no additional materials—merely the same care and good workmanship regularly employed.

3. Better concrete: Makes concrete more workable, more plastic, more cohesive and more uniform throughout.

4. More durable concrete: Requires less mixing water for a given slump; minimizes segregation and bleeding; tends to reduce manipulation scale; fortifies the concrete against freezing and thawing weather; renders paving concrete highly resistant to scaling action of de-icing salts.

5. Makes better concrete block: Reduces breakage, improves appearance, lowers water absorption and generally increases strength.

6. Called Duraplastic because it makes concrete more durable and more plastic.

Atlas Duraplastic air-entraining portland cement was originated and developed by Universal Atlas Cement Company. It is backed by eleven years of field and laboratory tests and research and proved by seven years of successful field performance. Duraplastic is specified by an increasing number of architects, engineers, contractors, dealers, ready-mix operators and concrete products makers. It is used for general concrete work—for paving, sidewalks, foundations, walls, gunite, slip-form work and concrete pipe and block.

Send for further information. Write to Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

RS-D-35

OFFICES: New York, Chicago, Philadelphia, Boston, Albany, Pittsburgh, Cleveland, Dayton, Minneapolis, Duluth, St. Louis, Kansas City, Des Moines, Birmingham, Waco.

"HOUR OF MYSTERY"—*Sponsored by U. S. Steel—Sunday Evenings—ABC Network*

A UNIVERSAL ATLAS PRODUCT

I Never Would Have Believed it!

"No, sir! I never would have believed it—but there it was—8 machines in one—ready to go into action at a moment's notice as a mower, or load-lifter, or bulldozer, or scraper, or V-type or one-way snowplow, or rotary broom. I am referring, of course, to that dependable, versatile piece of machinery, the HUBER MAINTAINER, with its many outstanding and important features that does all of these important maintenance jobs for one investment. Tell your local HUBER distributor to call you as soon as he has one to show you."

The HUBER Maintainer

Don't think of buying anything else but a HUBER MAINTAINER — that one-man maintenance crew that gets things done in a hurry—and at less cost.

THE HUBER MFG. COMPANY • MARION, OHIO, U. S. A.

HUBER MAINTAINER

ALSO 3 WHEEL AND TANDEM ROLLERS

America's Finest Highways are Reinforced with

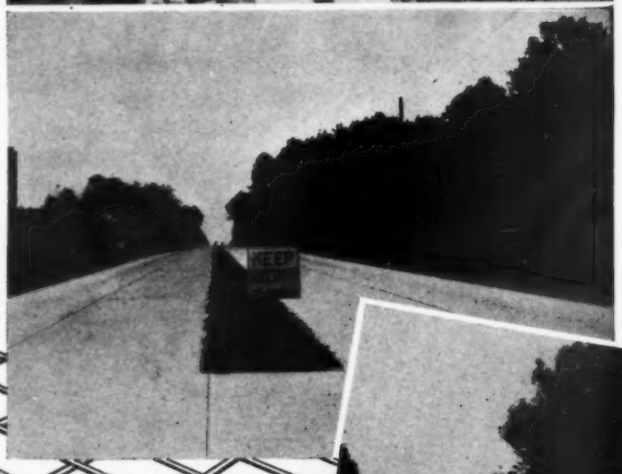
TRUSCON WELDED STEEL MESH

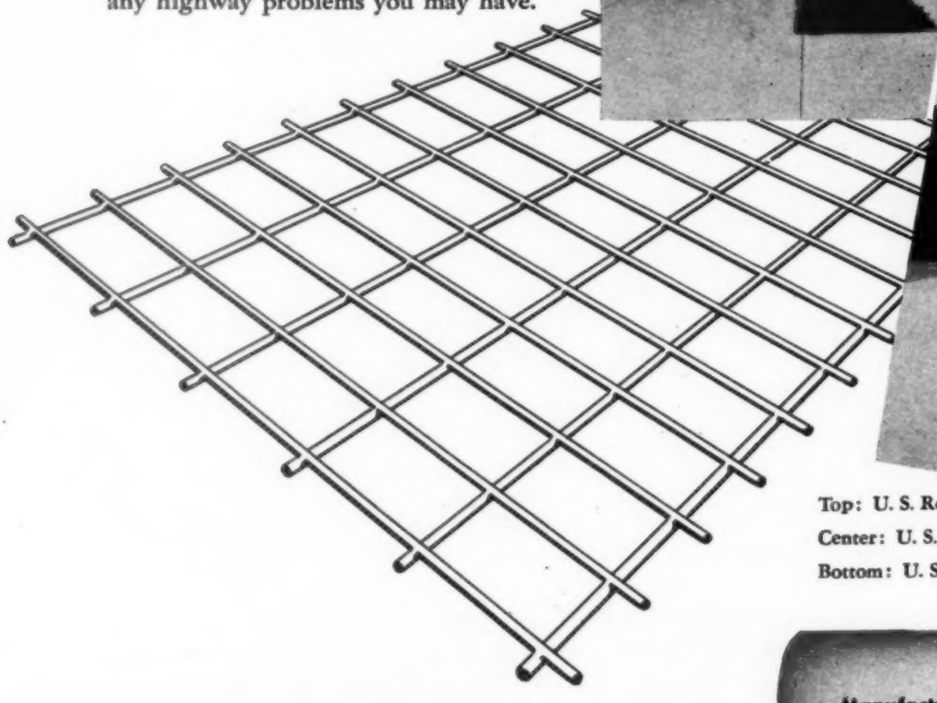
In every part of the country—North, South, East and West—there are smooth, easy-riding highways that have been made strong and durable with Truscon Welded Steel Fabric.

Actual installations have proved that Truscon Welded Steel Fabric assures long, economical life for concrete highways because it offers:

Resistance to cracking during setting period.
Tensile strength against subgrade friction.
Resistance to cracking due to warping.
Resistance to development and opening of cracks.
Resistance to slab separation.
Decrease of spalling and disintegration.

Be sure the roads you build have every one of these money-saving advantages by insisting on Truscon Welded Steel Fabric and associated products. The results will be smooth highways which will satisfy taxpayers and build greater prestige for you. A Truscon highway engineer will be glad to help solve any highway problems you may have.





Top: U. S. Route 1
Center: U. S. Route 30
Bottom: U. S. Route 250

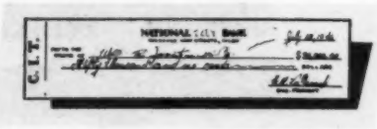
TRUSCON STEEL COMPANY

YOUNGSTOWN 1, OHIO • Subsidiary of Republic Steel Corporation

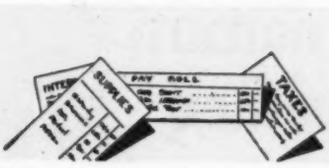
Manufacturers of a Complete Line of Welded Steel Fabric . . . Concrete Bars . . . Contraction Joints . . . Dowel Assembly Units . . . Curb Bars . . . Complete Steel Buildings.

CONTRACTORS: ***THE C.I.T. CONSTRUCTION EQUIPMENT PLAN HELPS YOU HANDLE MORE WORK PROFITABLY!***

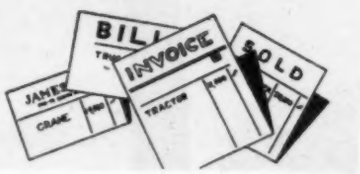
HERE'S HOW THE PLAN UNFOLDS



C.I.T. furnishes the funds to buy construction equipment. Any amount, promptly, AT LOW COST.



Conserves your funds for payrolls, supplies, materials. You may earn extra cash discounts.



You can combine several purchases in one long-term obligation. Saves time, bookkeeping, money.

You replace obsolete, worn-out and inefficient equipment. Handle more work with less effort.

Equipment helps pay for itself out of earnings. Spread the cost over many months.

Enables you to increase your business . . . earn larger profits . . . bid on larger contracts.

When you buy any type of construction equipment, LET C.I.T. FURNISH THE FUNDS TO COMPLETE THE TRANSACTION. Use our resources to equip yourselves with the proper machinery . . . conserve your own funds to carry on construction. Repay our advance over many months . . . handle more work on your present capital.

ANY OF THESE OFFICES ARE AT YOUR SERVICE . . .

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LOS ANGELES

In Canada: CANADIAN ACCEPTANCE CORPORATION *Limited, Metropolitan Building, Toronto, Canada*

AFFILIATED WITH COMMERCIAL INVESTMENT TRUST INCORPORATED

Here are 2,262,000 miles of ***mud in your eye . . .*** and on the windshields and mudguards of some 30,000,000 or more automobiles. Hundreds will bog down in it. There are that many miles of unpaved roads in this country. They are the roads that lace back and forth across the land, connecting millions of farms with their markets.

Through the Federal Aid Highway Act of 1944, many roads will be surfaced. We hope you are making plans—or have already made them—to surface some of the secondary roads in your part of the country.

And, naturally, we hope you will see the wisdom of using Koppers Tarmac for your road construction jobs. Tarmac is low in first cost and in maintenance; yet it is long-lasting, gives a smooth-riding, skid-resistant surface. Send for the booklet, "Surfacing with Tarmac."

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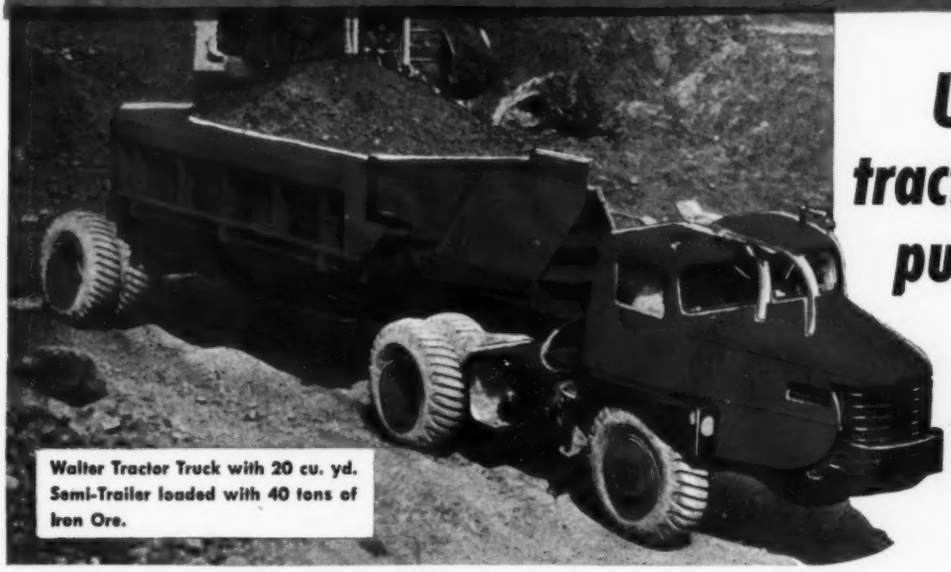
WALTER Tractor Trucks HAUL ANYTHING..Anywhere!



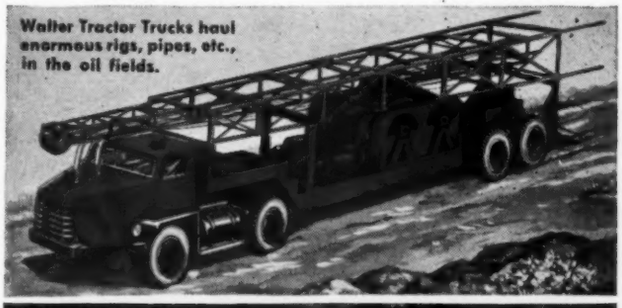
Walter Tractor Truck with 20 cu. yd. Semi-Trailer loaded with 40 tons of Iron Ore.

Unequalled traction and power pull huge loads through toughest terrain

The bigger the loads, the tougher the running, the steeper the grades — the more you need Walter Tractor Trucks. In mining, logging, oil fields, construction . . . wherever tough hauling jobs exist . . . you find Walter Tractor Trucks doing the "impossible." They are hauling payloads ranging up to 60 tons, through broken ground, slippery surfaces, mud and up steep grades — at speeds that make every hauling hour more productive.

Motor power alone cannot accomplish these hauling feats. It takes the unique Walter drive system . . . Four Point Positive Drive . . . to provide the necessary traction to utilize every horsepower. In this drive, three automatic locking differentials proportion the power to each of the FOUR driving wheels according to its traction at any instant. They never send power to slipping wheels, as in conventional 2- and 4-wheel drives. There is never any wheel spinning to bog down loads, gouge roads or grind tires.

Other valuable features include a final drive mounted above — not in — the axle, to provide high ground clearance, and protection against load strains and road shock; tractor type transmission for increased gear capacity; engine-ahead-of-wheels for correct weight distribution and shorter turning radius. Write for detailed literature.



Walter Tractor Trucks haul enormous rigs, pipes, etc., in the oil fields.

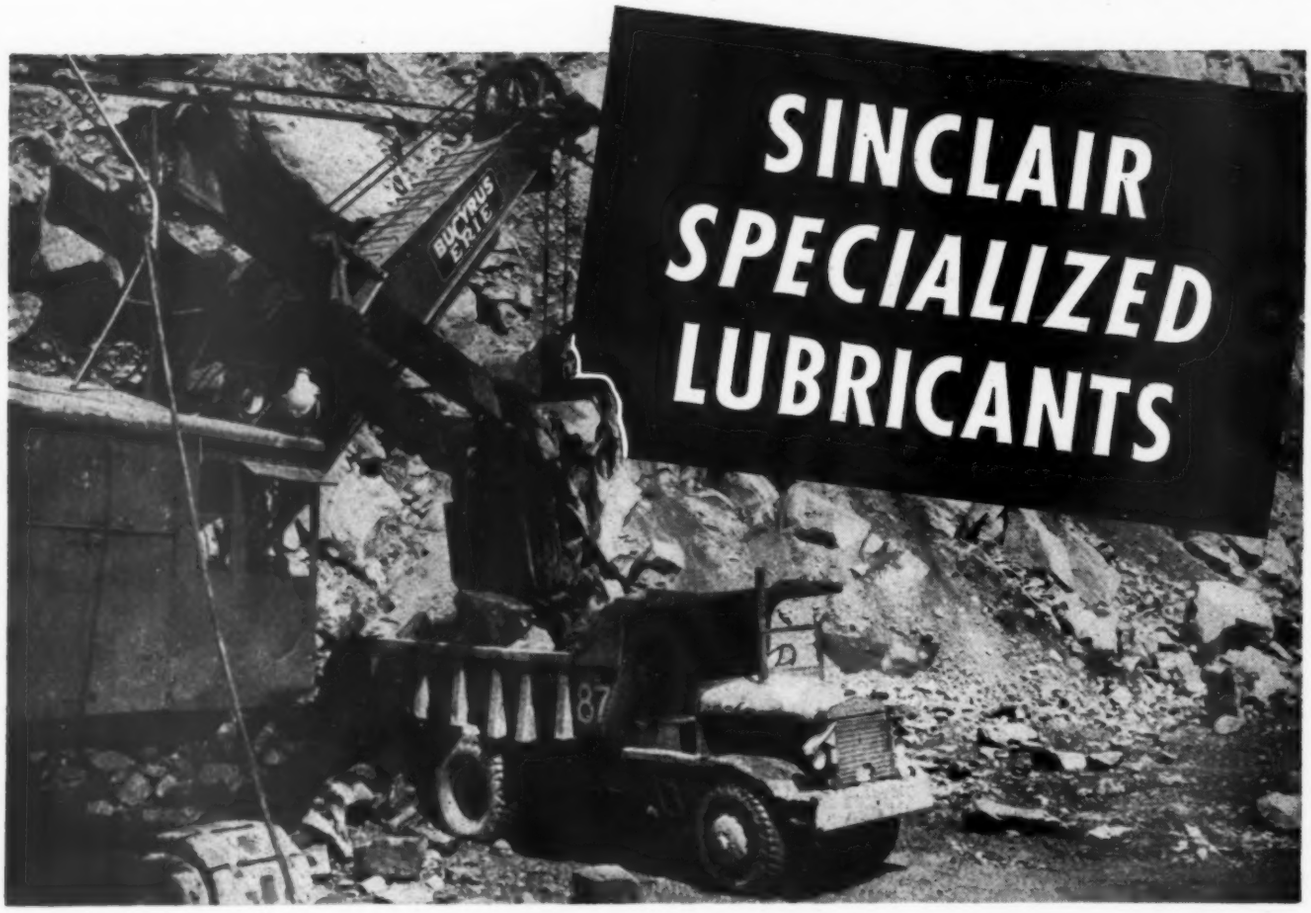
Walter Tractor Truck with 12 cu. yd. 20 ton payload capacity dump body.

Walter Tractor Truck hauling 60 tons of coal in Tandem Trailers.

WALTER MOTOR TRUCK CO.
1001-19 IRVING AVENUE, RIDGEWOOD 27, QUEENS, L. I., N. Y.

WALTER TRACTOR TRUCKS

Keep 'em on the Job...
with ***CORRECT*** LUBRICATION



A VITAL factor in keeping equipment available for continuous service is correct lubrication of *every part of the vehicle.* Failure of the smallest part—due to deficient lubrication—may put the entire machine in the shop . . . and shop time is non-revenue time.

Sinclair All-Point lubrication can be your guard against equipment lay-off. Sinclair lubricants are made for *specific* service at every individual point . . . to help keep machines moving.

Try . . . OPALINE MOTOR OIL for sure, safe engine lubrication . . . non-foaming OPALINE GEAR LUBRICANT with extreme pressure properties to prevent galling and scuffing . . . OPALINE CHASSIS LUBRICANT for stay-put protection in all weather . . . SINCOLUBE for assured, enduring wheel bearing lubrication.

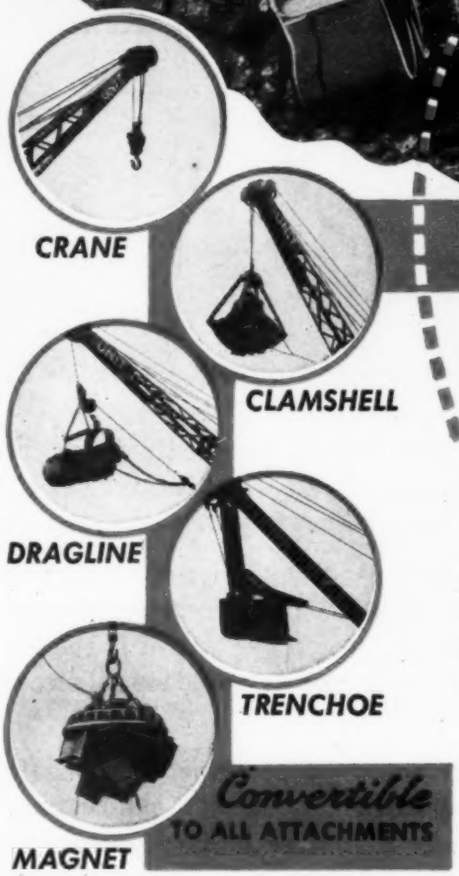
Let these tested lubricants help keep your equipment available . . . regularly and economically . . . always.

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

UNIT 514

So Easy to Handle



Convertible TO ALL ATTACHMENTS

Full-Vision Cab ...ENABLES OPERATOR TO SEE IN ALL DIRECTIONS

Here's a sturdy, nimble ½-yard excavator with compact, streamlined design . . . built for safe, efficient operation. Fast, finger-tip responsiveness. All controls within easy reach of operator. Automatic, foolproof traction brakes. New full vision cab, equipped with shatter-proof glass, promotes safety and increases operating efficiency.

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½ AND ¾ YD. EXCAVATORS — *5 TO 10 TON CRANES*

UNIT CRANE & SHOVEL CORP.

UNIT CRANE & SHOVEL CORP. UNIT MILWAUKEE WISCONSIN

6407 W. BURNHAM ST.
MILWAUKEE 14,
WISCONSIN, U.S.A.

A 4873-1PCR-2

← State Route 51 near Georgetown, S. C., after 8 years of service. 6.8 miles of soil-cement base constructed from existing roadway soil and small addition of portland cement.

Typical light-traffic street of soil-cement base in the Lakewood Subdivision, Erie County, Pennsylvania. →

SOIL-CEMENT

Today's Biggest Value For Lighter Traffic Roads and Streets

THE *superior value and durability* of Soil-Cement paving for lighter traffic roads, streets and airports has been proved in the building of more than 39 million square yards of such paving in the United States.

The economy of Soil-Cement has been well established too. Construction costs naturally are low because about 90 per cent of the required Soil-Cement materials is usually found on existing unsurfaced roads and streets.

With Soil-Cement you can also transform old high maintenance gravel and stone roads into strong, long-lasting pavements which give years of continuous all-weather service. *It's like finding extra money in your paving budget.*

Compare the cost and service of other types of paving intended for the same purpose, with Soil-Cement, and you'll see why it is the logical choice for your lighter traffic roads, streets and airports.

Send for free copy of "Specifications for Soil-Cement Road and Street Construction," to help complete your secondary paving program. Distributed only in U. S. and Canada.

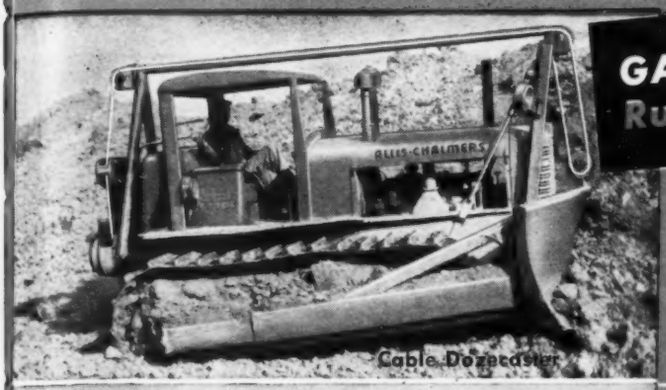
PORTLAND CEMENT ASSOCIATION

Dep't. 7-28, 33 West Grand Avenue, Chicago 10, Illinois

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

Down-to-Earth Engineering

GAR WOOD Cable Controls Feature Rugged Simplicity and Direct Action Pull



Cable Dozecaster

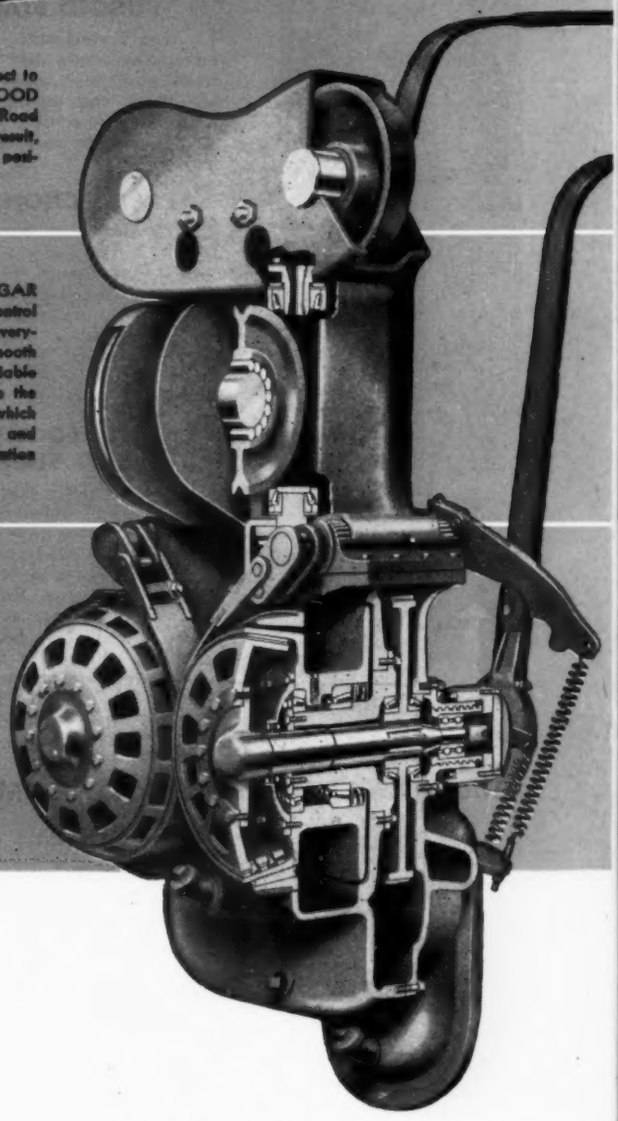
The cable goes direct to the job in GAR WOOD Cable-Controlled Road Machinery. As a result, it has fast action, positively controlled.

Heavy-Duty Cable Ripper

The Job-proved GAR WOOD Cable Control Unit (right) has everything it takes for smooth operation and reliable performance. Note the sturdy steel housing which prevents distortion and serves as a lubrication chamber.

Wheel Cable Scraper

Outside clutches and servo-type, self-energizing brakes cool themselves and are readily accessible. Roller bearings throughout and spur-type gears keep adjustments at a minimum.



PROVED through the years on the toughest of jobs. Made more rugged than ever by the lessons learned in war action on every front, from Guadalcanal to Okinawa and from Oran to Berlin.

GAR WOOD Road Machinery and the famous GAR WOOD Cable Control Power Unit offers practical design and sound construction, well engineered and honestly built—equipment that *holds together* and can be operated with an absolute minimum of down time. *If it's* GAR WOOD, *it's good.*

See your Allis-Chalmers dealer. He'll be happy to give you all the facts and show you Gar Wood Earth Moving Equipment *on the job* in your own vicinity.

GAR WOOD ROAD MACHINERY
WITH ALLIS-CHALMERS DIESEL POWER

Gar Wood 2-Wheel Hydraulic Scraper and Bulldozer

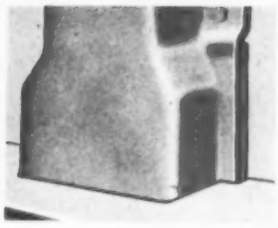
Gar Wood Hydraulic Dozecaster.

Sold Through
ALLIS-CHALMERS
Dealers Everywhere

ROAD MACHINERY DIVISION
GAR WOOD INDUSTRIES, INC.
DETROIT 11, MICHIGAN

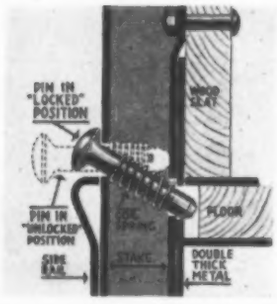
OTHER GAR WOOD PRODUCTS: HOISTS AND BODIES • TANKS • WINCHES AND CRANES • HEATING EQUIPMENT • MOTOR BOATS

PERFECTION STAKE BODY FEATURES



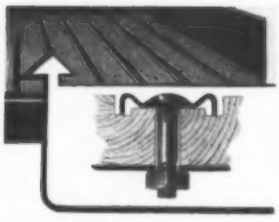
RUGGED STAKES

The heavy steel stakes are made *extra wide* where they fit into the stake pockets—to assure a durable, rigid, and secure anchorage. The bottom of stake is additionally strengthened by an *extra thickness* of metal.



STAKE SECTION LOCK

Rear stake section securely locked in place by heavy pin inserted completely through stake and extending under inside edge of side rail. Strong spring holds pin firmly in place in either "locked" or "unlocked" position. Note how bottom portion of stake is reinforced by double thickness of metal.



INTERLOCKING SKID STRIPS

Heavy rolled steel skid strips protect abutting edges of all floor boards from splintering. Floor boards are securely anchored to each body bolster by bolts inserted through skid strips. Ribbed design of skid strips acts as full-length clamp to hold floor boards tightly in place. Note how floor boards are grooved to take care of skid strips. Design allows for contraction and expansion caused by temperature and moisture.

The PERFECTION STEEL BODY COMPANY
GALION, OHIO

Mountable as stationary or dumping units. Write for complete data.

PERFECTION
TRUCK BODIES AND HOISTS

THE combined research, production and distributing facilities of three famous companies are now offered to American industry by The Colorado Fuel and Iron Corporation. Thus, a new nation-wide service is made available in steel, wire products, and allied specialties under the trade-marks of Wickwire Spencer, Calwico, and CF&I—each a standard of industrial progress in its own right.

The East and Middle West will continue to be served by Wickwire Spencer Steel Division. The Colorado Fuel and Iron Corporation will serve the Plains and Mountain States with CF&I facilities as before plus the products of the eastern and western divisions. The California Wire Cloth Corporation (a subsidiary) will supply its own products and in addition the products of the other two divisions to Pacific Coast customers.

The well-earned reputation for quality which these three companies have enjoyed will be maintained in the new and greater Colorado Fuel and Iron Corporation.

CF&I
WICKWIRE SPENCER STEEL DIVISION
The Colorado Fuel and Iron Corporation
THE CALIFORNIA WIRE CLOTH CORPORATION
EASTERN SALES OFFICES 30 Church St., N.Y. 13, N.Y. — EXECUTIVE OFFICES DENVER, COLORADO — WEST COAST OFFICES OAKLAND, CALIFORNIA — KEY CITY OFFICES SEE PHONE BOOK

more people steer the Gemmer way

Because it is the simplest means to easy steering of buses, trucks, tractors and road machines, Gemmer Steering is found in more types of automotive vehicles and in more of them than any other. Sturdy in its inherent design and fine construction — the Gemmer Steering Gear with reasonable care should last and give satisfaction for the life of the vehicle.

Steering is always firm, responsive, positive, with absence of rubbery feeling or wander. Design banishes lost motion and minimizes wear. Power for parking is abundant.

STEER THE GEMMER WAY

1574

GEMMER MANUFACTURING CO. 6400 MT. ELLIOTT DETROIT 11, MICH.

How a B-G *Central Plant* Provides Positive Control of Aggregate Gradation

• There is positive gradation control of aggregate in a Barber-Greene Central Plant when the Gradation Control Unit is used. The aggregate is accurately sized *after* the drying operation, and there is no manual weighing or processing required.

A continuous flow of material in a relatively small stream from stock pile to finished mix in the trucks removes any problem of segregation. Locked calibrated gates maintain a uniform flow of aggregate. The aggregate feeder is interlocked with the bitumen pump, keeping the proportion well within the most rigid specification requirement.

These Central Plants are low in cost, quickly set up or moved, and can produce any type of mix required. Write for illustrated catalog, explaining the continuous mixing principle exclusive with the Barber-Greene line. Barber-Greene Company, Aurora, Illinois.

Teammate of B-G Asphalt Plants is the Tamping-Leveling Finisher, *the machine that puts down a compact mat of unparalleled smoothness.*

48-9

B-G Barber-Greene CONSTANT FLOW EQUIPMENT

LOADERS • PERMANENT CONVEYORS • DITCHERS • PORTABLE CONVEYORS • FINISHERS • BITUMINOUS PLANTS • COAL MACHINES

Chrysler Industrial Engines Prove Their Versatility — Flexibility — Dependability

Out in the field where class tells—that's where Chrysler Industrial Engines are bringing economical and rugged power to owners in many types of applications.

Here are some good reasons why these engines deliver thousands of hours of low cost power:

They are designed, engineered and built completely in the great Chrysler plant.

Chrysler engineers introduced compact, high compression horsepower more than 22 years ago —the basis for flexibility, versatility and a dependable power flow under varying loads and speeds.

Engine parts subject to wear are Superfinished to a mirror smoothness—assuring longer hours of operation and lower maintenance costs.

Put Chrysler "Pedigreed" horsepower to work for you now. Mail the coupon today for complete information on Chrysler Industrial power units.

•

Attention dealers: Some desirable Chrysler Industrial Engine territories are available. Write to the Chrysler Industrial Engine Division at the address below for complete information.

CHRYSLER
INDUSTRIAL ENGINES

Horsepower with a Pedigree

Industrial Engine Division, Chrysler Corp.
12208 East Jefferson, Detroit 31, Michigan

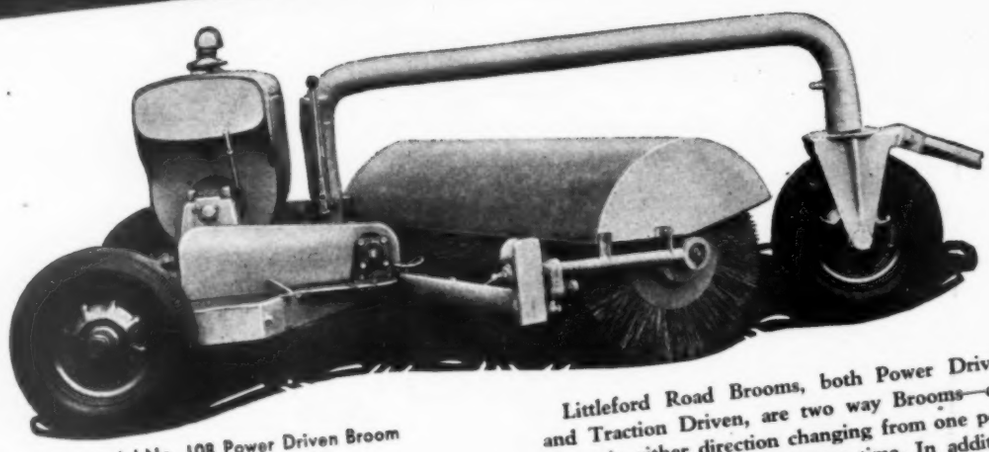
Please send the Chrysler Industrial Engine Catalog.

Name_____

Address_____

7 City_____ State_____

THESE LITTLEFORD BROOMS CAN BE CHANGED FROM ONE SWEEPING DIRECTION TO ANOTHER IN 2 MINUTES TIME

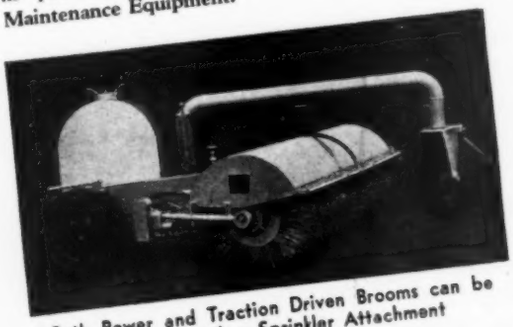


Littleford Model No. 108 Power Driven Broom

Littleford Road Brooms, both Power Driven and Traction Driven, are two way Brooms—can sweep in either direction changing from one position to the other in 2 minutes time. In addition the Littleford Brooms have a Hydraulic Lift for regulating the tension of the brush on the road surface—this saves the wear on the Brush.

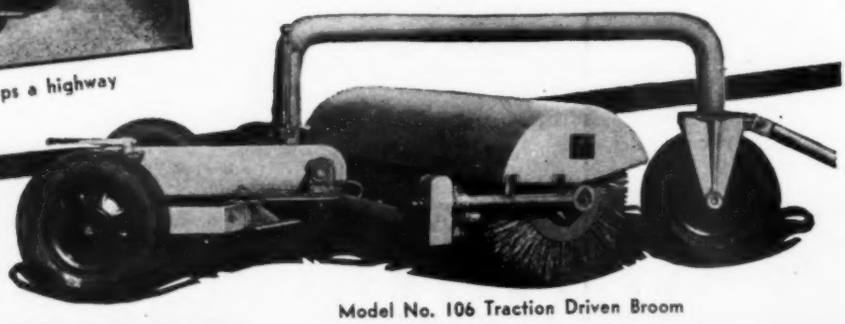
These are a few of the many features found on Littleford Brooms. Again Littleford leads the way in producing efficient Road Construction and Maintenance Equipment.

Blower Attachment can be added to Power Broom



Both Power and Traction Driven Brooms can be equipped with a Sprinkler Attachment

Traction Driven Broom sweeps a highway



Model No. 106 Traction Driven Broom

BLACK TOP ROAD MAINTENANCE EQUIPMENT SINCE · 1900

LITTLEFORD LITTLEFORD BROS., Inc.

454 E. PEARL ST., CINCINNATI 2, OHIO

TOMORROW'S WAY

is yours Today!

BUCKEYE VACUUM POWER CONTROL

Tomorrow's way in power shovel operation is automatic control, and the tops in automatic control is *metered vacuum power control*—exclusive on Buckeye Clipper 1/2 and 3/4 yard convertible shovels *today*.

Vacuum power control eliminates the fatiguing pound and jerk of manual control but retains the full "feel" of operations; crowd, hoist, swing, dump and travel.

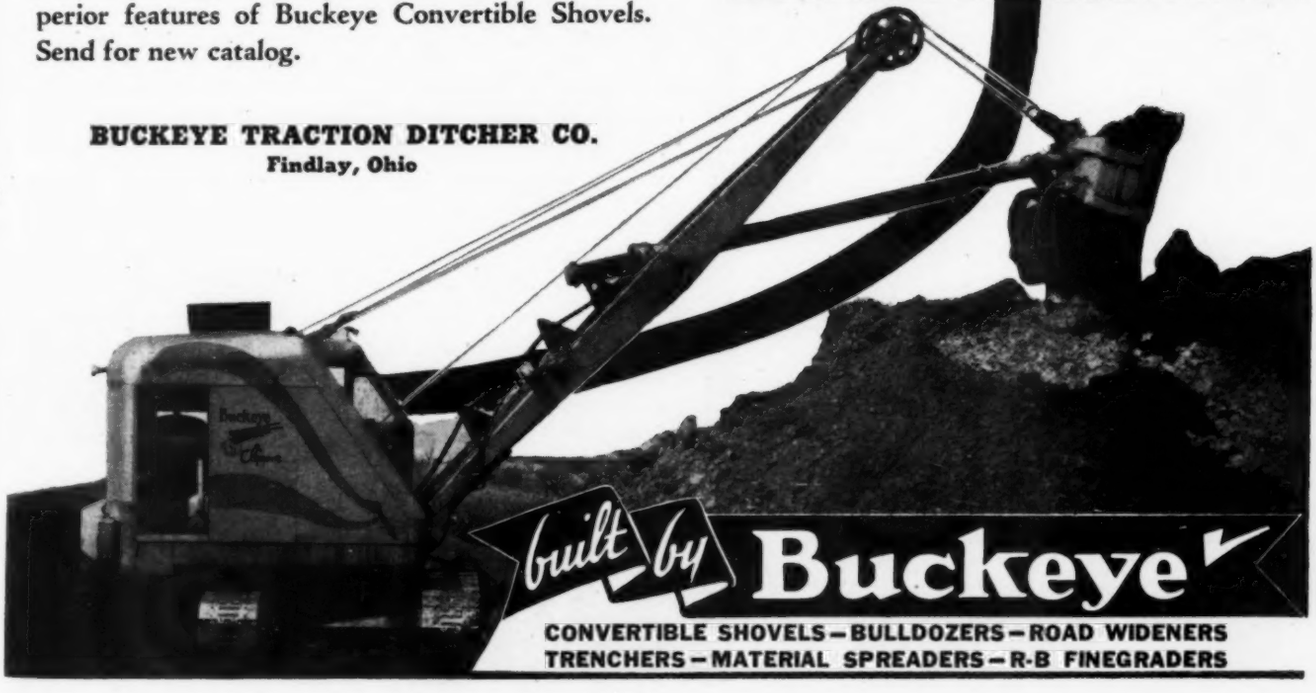
Metered vacuum power control is the simplest of automatic control systems—no troubles arising from leakage, condensation or frozen lines—requires minimum maintenance—no refills of hydraulic fluid.

Metered vacuum power control saves fuel, cuts wear and tear, and reduces maintenance costs. All front end attachments—shovel, trench hoe, crane—respond faster, smoother and better.

Buckeye Clippers bring new ease and economy to power shovel operation. It's tomorrow's way and it can be yours *today*. Discover the many superior features of Buckeye Convertible Shovels. Send for new catalog.

- ✓ Fast, positive response — eliminates the time lag
- ✓ Minimizes operator fatigue
- ✓ Provides complete "feel" of all operations
- ✓ Increases life of clutch and brake lining
- ✓ Greatly reduces maintenance costs
- ✓ Assures smooth, simultaneous crowd, hoist, swing and travel

BUCKEYE TRACTION DITCHER CO.
Findlay, Ohio



built by **Buckeye**

CONVERTIBLE SHOVELS—BULLDOZERS—ROAD WIDENERS
TRENCHERS—MATERIAL SPREADERS—R-B FINEGRADERS

A single-cylinder, twin-arm hoist for 1½ to 2½ ton trucks.

A twin-cylinder, twin-arm hoist for 8 to 20 ton trucks.

A twin telescopic hoist for rock and ore bodies.

BH-117

Heil Bodies and Hoists are built to lick the *Tough Jobs*

The ability of Heil Bodies and Hoists to give you extra years of profitable service has been proved wherever tough working conditions test soundness of design and quality of materials.

Heil units are built to take the punishment of the tough jobs . . . to give you quick, clean dumping under all operating conditions . . . extra speed that enables you to haul more loads per day . . . and more profit on every load you haul.

Compare such features as the heavy-duty sub-frame . . . reinforced body floor . . . simple arm construction . . . precision-machined pump . . . etc. — and you see why Heil quality construction assures you of dependable, profitable service with a minimum of "time out" for service and repair.

For complete details, see your Heil distributor.

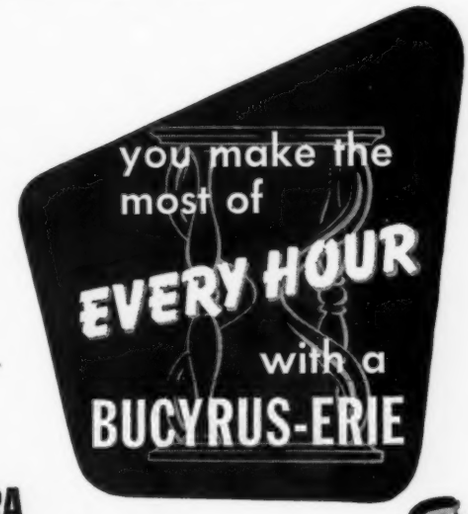
ARMY E NAVY

THE HEIL CO.

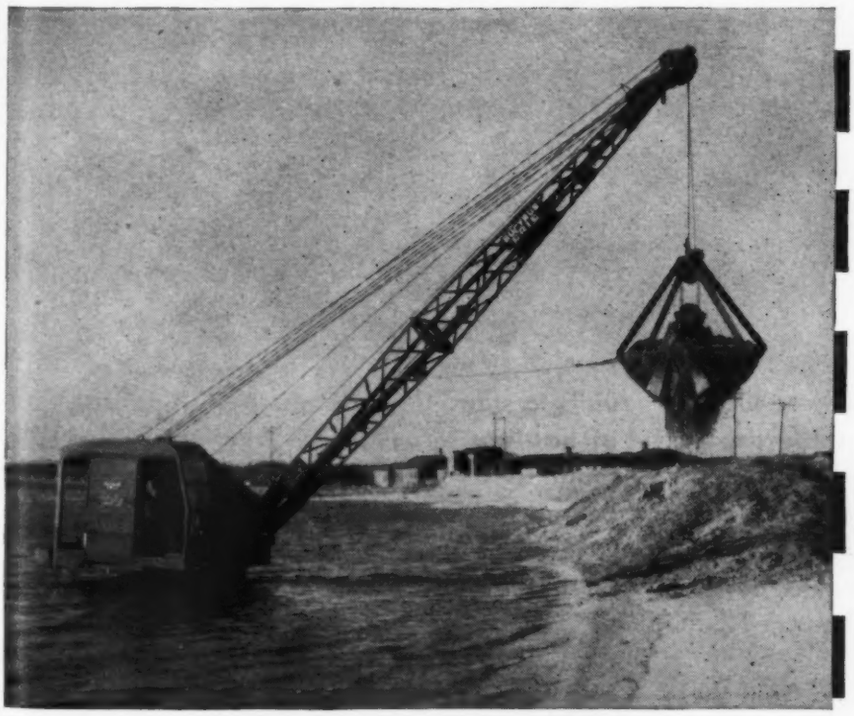
GENERAL OFFICES • MILWAUKEE 1, WISCONSIN

no *time out* for wet feet

IT'S characteristic of Bucyrus-Erie 3/8 to 2½-yard excavators to wade right in and slug it out with the tough jobs — staying in there digging, shift after shift, delivering the high percentage of actual working time that really boosts output.



YOU ADD EXTRA OUTPUT WITH THE EXTRA DIGGING TIME BUCYRUS-ERIES GIVE YOU



Here are 8 reasons why

1. All adjustments are easily made and lasting.
2. Parts are simple, large, few in number and enduringly aligned — there's little to go wrong.
3. Machinery is accessible for quick, easy repairs, parts replacement, and lubrication.
4. The digging cycle is balanced, coordinated, fast. There's no overstressing of parts to cause too-frequent adjustments and repairs.
5. All controls are conveniently grouped in one place — no hopping about the machine to cause digging delays.
6. Performance is smooth, quiet — easy on both machine and operator.
7. Design is individual — each machine is especially fitted to its range of work.
8. Moves are fast, sure. Machine is easily steered, makes sharp or gradual turns, climbs grades to 30%.

52E46

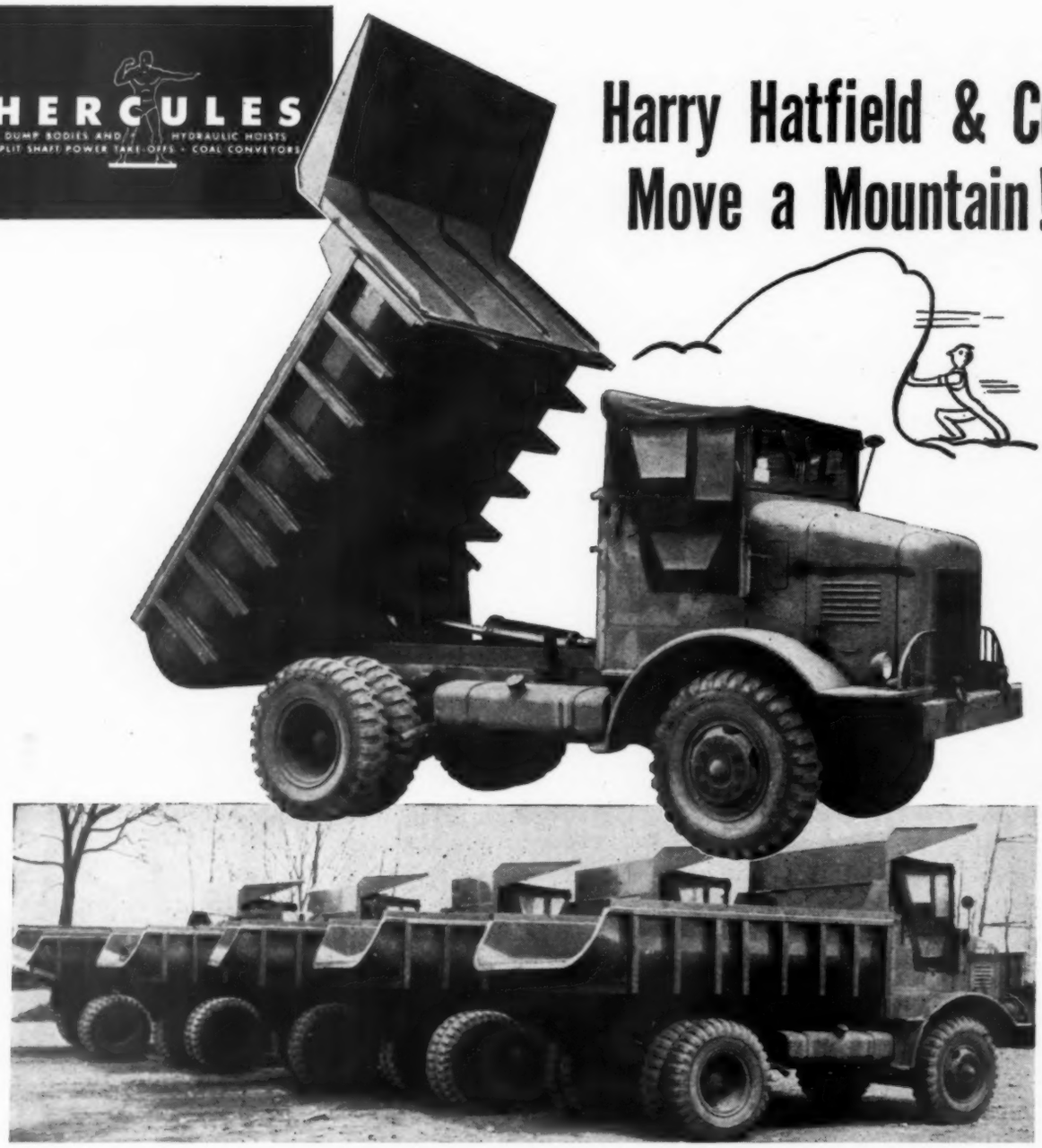
BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

HERCULES

DUMP BODIES AND HYDRAULIC HOISTS
SPLIT SHAFT POWER TAKE-OFFS · COAL CONVEYORS

Harry Hatfield & Co. Move a Mountain!



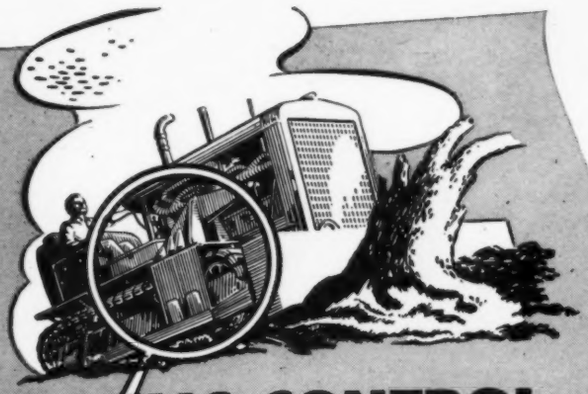
600,000 cubic yards of stone—enough to make a mountain of respectable size—is being moved in ten of these Hercules Rock Body dump units, owned and operated by the Harry Hatfield Co., Barboursville, West Virginia. Moving a mountain is no easy task, and Mr. Hatfield will need all the help he can find.

And he'll get plenty of help from these sturdy Hercules Rock Bodies! Built-in stamina, the result of years of design and manufacturing experience, will enable these units to stand up under the punishing task of hauling heavy loads over irregular, rough terrain. When the job is done, they'll be ready for more heavy-duty service!

Maybe you aren't planning to move a mountain at the moment, but if you've got a hauling and dumping job that's tougher than you figured, you'll want to know why Hercules Rock Bodies can deliver low-cost, dependable performance on the toughest jobs. Details are available . . . just address Department 1.

HERCULES STEEL PRODUCTS COMPANY . . . GALION, OHIO

Overload DOES NOT DAMAGE Construction Equipment having VICKERS HYDRAULIC CONTROL



NOTHING SNAPS—NOTHING BREAKS

Overload protection is *built into* Vickers Power Hydraulic Controls for construction equipment. A relief valve stands guard on each circuit, so when overload occurs, the valve opens—returns oil to the tank—relieving the strain.

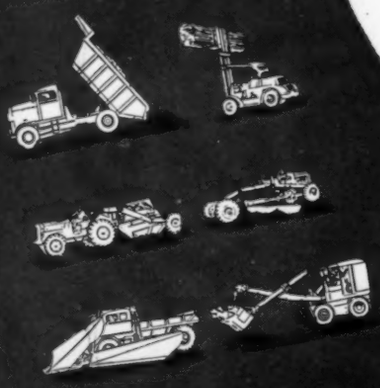
Nothing is injured. When the overload is cleared, the relief valve automatically closes, and the circuit is ready to go back to work.

Overload cannot damage equipment having Vickers Power Hydraulic Control—it cannot even cause any inconvenience—the relief valve takes care of it.

The effect of this automatic protection on the life of the equipment is obvious. But there is another advantage—the operator doesn't have to "baby" the machine. He knows there is overload protection—hence he can work as fast and crowd as hard as he likes—an important feature when the "going is tough."

For easier and more accurate control—faster work—specify Vickers Power Hydraulic Controls.

Representative Applications of Vickers Power Hydraulic Controls



VICKERS Incorporated

1432 OAKMAN BLVD. • DETROIT 32, MICHIGAN

Application Engineering Offices: Chicago • Cincinnati Cleveland • Detroit • Los Angeles • Newark • Philadelphia Rochester • Rockford • Tulsa • Worcester

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

The Leader
IN WELDED CONSTRUCTION

WELLMAN

Williams Type BUCKETS

Wellman pioneered in the welded construction of rolled steel buckets. Priceless experience, superior engineering and the finest type of construction guarantee you more satisfaction from your Wellman-built buckets.

SEND FOR BULLETIN

THE WELLMAN ENGINEERING COMPANY
7003 CENTRAL AVENUE • CLEVELAND, OHIO

It's On-the-Job Performance that Really Counts

The catalog claims, the salesman's sales talk are quickly proved or disproved "on the job". That's why we ask you to check our statements against the record. Hanson owners and operators everywhere endorse the matter-of-fact statement that "Hanson has the answer to your excavator needs".

Specifications in brief: ⅜ or ½ yd. capacity as a shovel – 4½ or 6½ ton lift as a crane – all welded steel construction – Timken Roller Bearings at vital points – bronze bushings at all other points of wear – chain crowd – full revolving – low center of gravity – special Hanson clutches, easily adjusted and relined without dismantling shafts – extra long crawlers – air controlled steering – heavy duty industrial type gasoline or diesel motors – quickly convertible to: CRANE, DRAGLINE, CLAMSHELL, PILE DRIVER, TRENCH-HOE, SHOVEL.

Write for complete specifications and catalog RS-76.

THE **HANSON** CLUTCH AND MACHINERY CO. TIFFIN, OHIO

OUTSTANDING ability of Firestone Earthmovers to furnish maximum flotation for capacity loads is recognized by earthmoving contractors the world over. Designed for free-rolling wheels of scrapers, tractor and trailer wagons and buggies, the low pressure Earthmover with its large cross sectional diameter rolls easily over sand, loose fill and gumbo. The extra tough, cut-resistant tread design keeps heavily loaded units from side-slipping or skidding on side hill hauling. The tire body, made of heaviest, strongest rayon has *four extra tread plies* to cushion impact blows which cause failure in less rugged tires. Double thick sidewalls protect against rutwear and snagging. *Firestone Earthmover tires, working for you on your equipment, will cut your operating time — and costs — to the minimum.*

Listen to the "Voice of Firestone" every Monday evening

GROUND GRIP

Designed to transmit greatest possible traction to drive wheels of earthmoving equipment, this tire outpulls, outdrives, any tire ever made.

ROCK GRIP EXCAVATOR

Combines great stamina and extra traction in toughest trucking operations, quarrying, logging, construction work, ore and coal strip mining.

Firestone OFF-THE-HIGHWAY TIRES

Copyright, 1946, The Firestone Tire & Rubber Co.

For low cost maintenance!

2-4 Dow Weed Killer

kills weeds easily - completely - chemically

2-4 Dow Advantages

√ Harmless to ordinary grasses

√ Easier and safer to handle

√ Noncorrosive to spraying equipment

At last—an easy, *chemical* way to kill weeds. Simply spray the tops with 2-4 Dow Weed Killer and kill roots and all! It's a low cost treatment that eliminates your weed problems—*and* the tiresome job of hand digging and hoeing. Does not harm common grasses when used as directed.

2-4 Dow Weed Killer is the tested product you've been reading about. Use it wherever weeds must go so grass can grow—lawns, parks, playgrounds, golf courses, cemeteries and airfields. And for better maintenance—along highways, railroads and utility lines. 2-4 Dow Weed Killer is available in both powder and liquid form. It comes conveniently packed in sizes for every need.

See Your Dealer or Write Direct!

And ask about Dow Selective Weed Killer, to control weeds in grains; Dow Contact Herbicide to kill weeds and grasses.

AGRICULTURAL CHEMICAL DIVISION

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago • St. Louis
Houston • San Francisco • Los Angeles • Seattle

DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

When You're Traxcavating, You're PROFIT-MAKING!

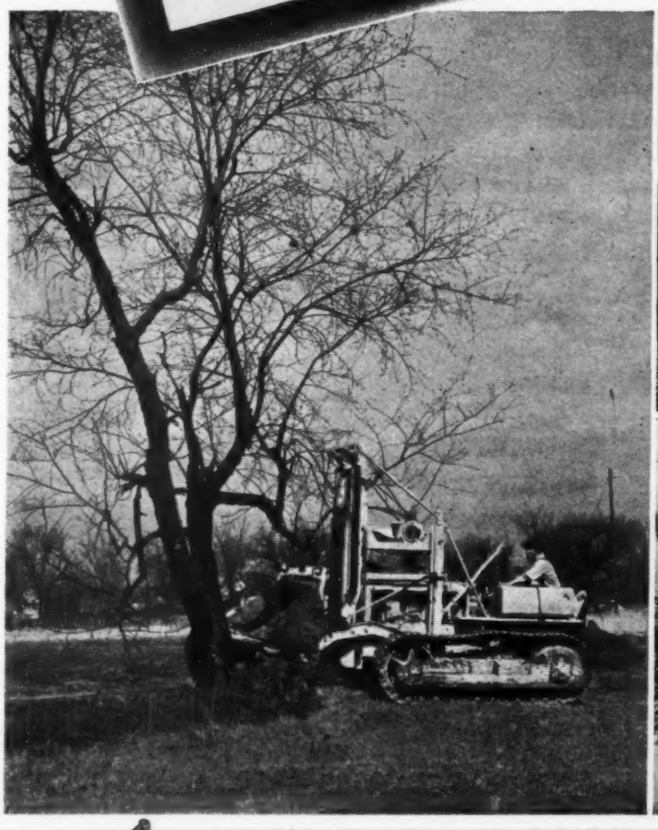
TRAXCAVATORS get things done! Put them to work digging, loading, carrying, grading and watch your hourly production climb — your operating costs fall. TRAXCAVATORS are seldom idle because these versatile, multi-purpose machines combine the usefulness of a shovel, loader, scraper, bulldozer — and with the available interchangeable attachments, they are the "workingest" machines you ever saw. More work, on more jobs, more days in the year mean low-cost, top notch performance and greater profit.

TRAXCAVATORS are built in several sizes — for every job and purpose — with bucket capacities from ½ to 2½ cubic yards. Each is a balanced unit with the rugged "Caterpillar" track-type tractor by which it is powered. Learn now why it pays you to *traxcavate*—get the facts from your TRACKSON-"Caterpillar" dealer or write direct to TRACKSON COMPANY, Dept. RS-76, Milwaukee 1, Wisconsin.

At Left: TRAXCAVATOR removing a tree for street widening

Upper Right: The same machine handles the grading for street widening

Lower Right: TRAXCAVATOR handling pipe on sewer construction, also cleared and graded the right of way

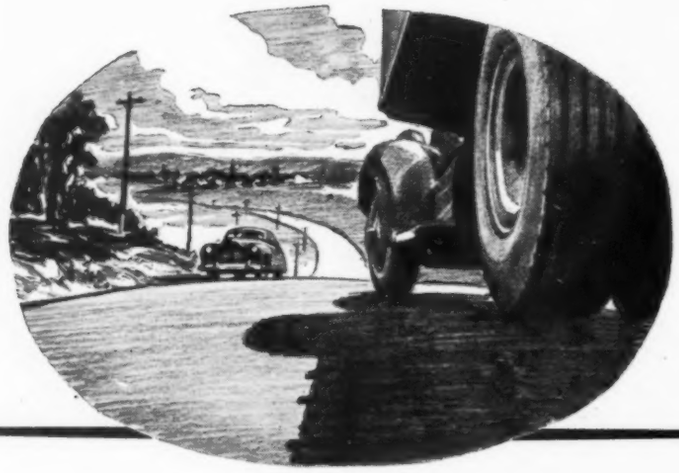


TRAXCAVATOR

REG. U. S. PAT. OFF.

THE ORIGINAL TRACTOR EXCAVATOR

DIGS GRADES LOADS CARRIES



NATIVE SOILS
will bear the traffic

There are probably hundreds of miles of roads in your area which have not carried enough traffic to justify the high cost of paving.

These are the roads that have been neglected. But they are now the roads that can benefit through the new methods of soil stabilization. For here is a process that makes it possible to build highly serviceable roads utilizing native, in-place materials, thus reducing to a minimum—or eliminating—one of the major cost factors in road construction.

With its long experience in designing earth-handling machinery, P&H has worked in cooperation with road-building authorities to produce a machine that now fulfills the 8 basic requirements in processing native soils in the most efficient manner—*at a single pass.*

The *P&H Single Pass STABILIZER* is capable of handling all types of admixtures and providing the accurate control that makes it possible to build all-weather roads of pre-determined load-bearing ability in a way that will cut both building and maintenance costs.

Those interested in the building of base courses, light traffic roads, streets, airport-runways, etc., should obtain complete information.

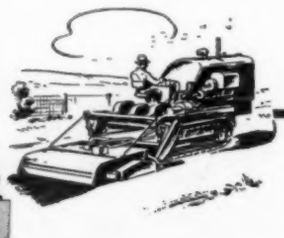
P&H

HARNISCHFEGER CORPORATION

EXCAVATORS • ELECTRIC CRANES • ARC WELDERS P&H HOISTS • WELDING ELECTRODES • MOTORS

SINGLE PASS STABILIZERS

4496 W. National Avenue
Milwaukee 14, Wisconsin



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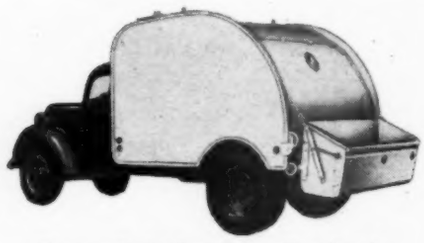
Type C28 scow end Garbage Body. Steel hinged covers extra equipment.



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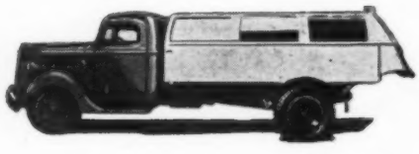
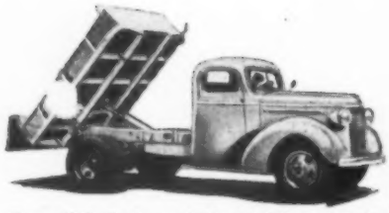


Type C50 Garbage Body with sliding steel covers on each side.

Model "QD" Tree-moving Crane. Easily erected or removed from all purpose stake body.



Type C12 Body and Model D6 or D7 Hoist. Dumping angle 55°.

Telescopic boom Crane. Boom radius 8 to 20 feet.

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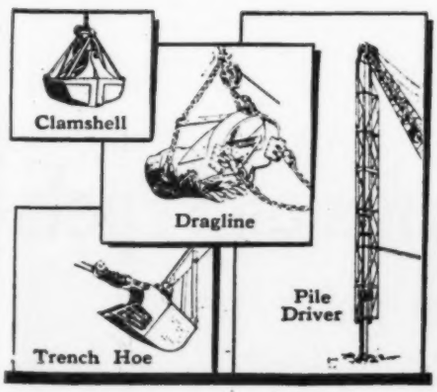

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ROADS AND STREETS

JULY, 1946 • VOL. 89 • No. 7

Deep Water Piers

Built "Open Hole" without Seal

Steel sheeting driven to rock at —50 ft. and clamped "silo" fashion around special circular cage to eliminate leakage; deck concrete pumped into place, using forms obtained by cutting up falsework piling. Kansas City Bridge Company contractor on two adjoining bridge projects in Oklahoma.

Harold J. McKeever
Editor, ROADS AND STREETS

WHAT is believed to be a record or near record in "open dry" pier construction was achieved recently on two highway bridges in Northeastern Oklahoma, under contract by the Kansas City Bridge Company. The structures will carry state highway 10 over Elk River and Honey Creek, respectively, which are now drowned valleys in 72-square-mile Lake of the Cherokees, created several years ago by the Grand River Dam Authority as a flood control and power project. The open methods of construction were aided by the absence of strong currents.

The Elk River structure is 800 ft. long and consists of 8 100-ft. continuous I-beam spans made up into two units having 4 continuous spans per unit. The Honey Creek structure is 400 ft. long and consists of one unit having 4 100-ft. continuous I-beam spans. Otherwise, the bridges are practically identical in design. The superstructure has concrete decks providing 26-ft. roadway and 2 3-ft. sidewalks and is supported on concrete piers embedded in rock and concrete abutments resting on steel bearing piles driven to rock. The contracts were awarded in 1945 at $330,000.00 and $187,000.00, respectively.

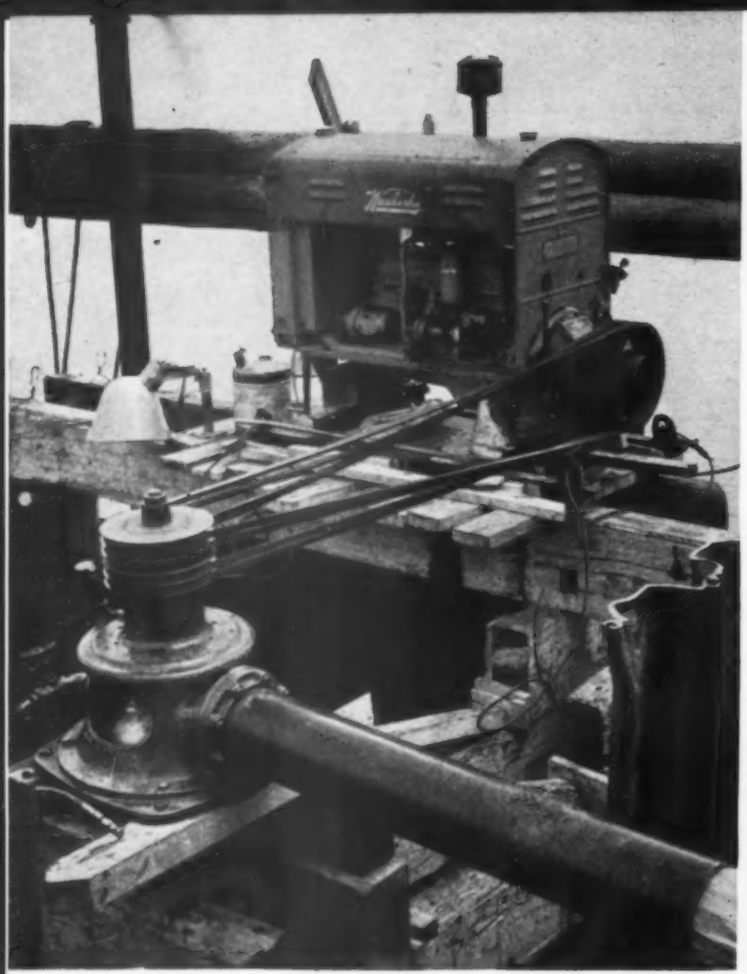
Details of Pier Construction

This is believed to be the deepest pier construction in which the specifications required dewatering and concreting in a dry hole. Piers were designed with forethought to problems of forming and construction, and detailed in such a manner that the same forms of special circular construction could serve both bridges, in the event that one contractor was awarded the two closely adjoining jobs. Each pier consists of two circular shafts, pyramiding from 11 ft. diameter footing to the top.

The specification was written for the open hole method, the contractor having the option of open-hole or caisson in bidding.

Work began on the bridges late in 1945 on completion of the approach fills by a different contractor (M. E. Gillioz of Monet, Mo.). The first pier at one end was undertaken first, then

★ Looking across the longer of the two bridges, across Elk River, during dewatering of the last pier



★ The main pumping load was carried by this 6-in. deep well pump with V-belt drive mounted permanently on top of the cofferdam

★ Form lumber—40,000 ft. of it!—was milled near the job from falsework piles. One and 2-in. boards were dressed on one side only

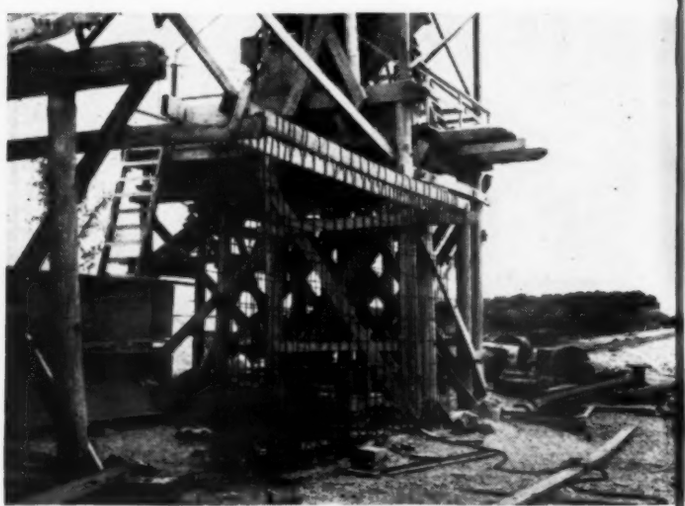


Photo by Sparlin

★ Reinforcing steel for the pier walls was assembled on this frame, carried out on the dinkey and set with the crane

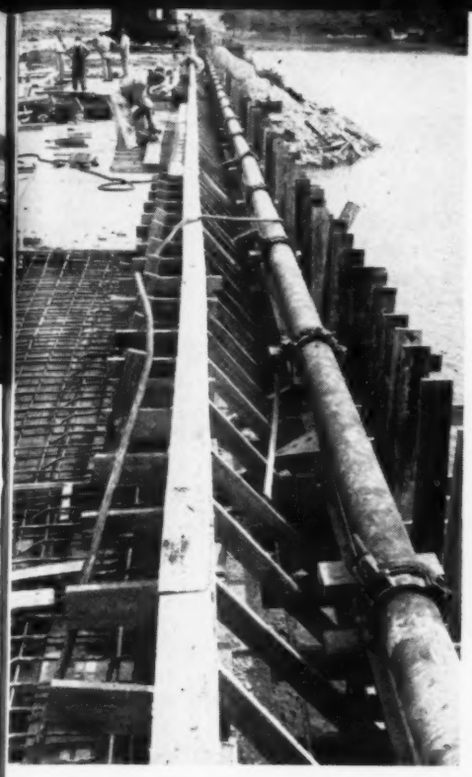
the adjoining abutment, after which pier construction was continued across water and the far abutment built last. Falsework consisted of pairs of wood pile bents driven on either side of each cofferdam. A steam crane traveling on top set falsework and handled deck girder and pier construction.

The first step in building each pier was to dredge the immediate site. Then a 21-ft. diameter circular steel cage or frame for the sheeting was set in two sections, this cage having been assembled on the bank. The cage consisted of fifteen "circles," each circle in turn comprising four rings of 6 x 4 x ½ paired angles bolted at proper spacing to heavy vertical posts. The rings thus fabricated were erected into a two-section cage. The first six lower rings were spaced at 2' 8", the next three at 3' 6", and the top six at 4' 0", giving a cage height of 52½ ft.

An important detail was the inclusion of a heavy timber ring at the base of the cage. The ring consisted of 12 x 12's set in octagonally and surrounded by 12-in. circular segments. The timbers added about two tons to the above-water weight of the lower half of the cage, but lessened the under-water load on the crane and aided in spotting and anchoring the cage.

The cage was set and the sections bolted together with the aid of a diver, after which steel sheeting was driven. The rock under each site is a limestone, fairly soft near the surface

★ (Left): Pumped concrete speeded up deck construction. Note canvas trunk or hood to help control outflow of concrete. (Right): Showing how the pipe was curved up to facilitate placement in working radius of short trough



★ Details of 8 in. concrete delivery pipe and pumping outfit. Pipe was supported on falsework cantilevered from bridge deck. About 25 cu. yd. per hour was being pumped through 460 ft. of pipe at time these photos were taken. The larger of the two bridges required a maximum of 900 ft. of pipe

but becoming extremely hard after penetrating one or two feet. Because it was possible to drive sheeting a foot or more into this formation, it proved comparatively easy (with exceptions) to meet the specifications which called for placing the footing in the dry.

8-in. Pumps Used

Pumping equipment consisted of an 8-in. deep-well turbine pump, and one or two 8-in. centrifugal pumps as needed. De-watering was usually accomplished in a single 9½-hour shift. The contractor gave special praise to the turbine pump, which could remain in a single position throughout the de-watering, whereas the centrifugals had to be lowered at successive stages.

De-watering an open cofferdam down to 45 or 50 ft. as required here, is no easy trick, and several refinements proved to be of vital importance. One was the use of shims behind the rings of the circular cage, as an aid in getting a more perfect circle of sheeting and equalizing pressure on the cage. Ordinary cedar shingles were employed. Another step which further eliminated leakage was to place a ¾-in. steel cable around the sheeting and draw it tight with a turnbuckle.

Cinders Cut Leakage

Of particular interest was another trick of choking leakage under the

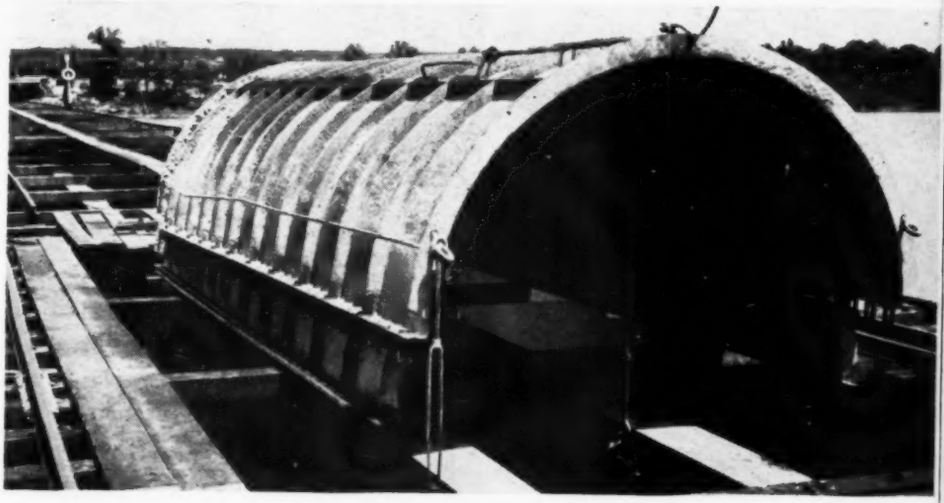
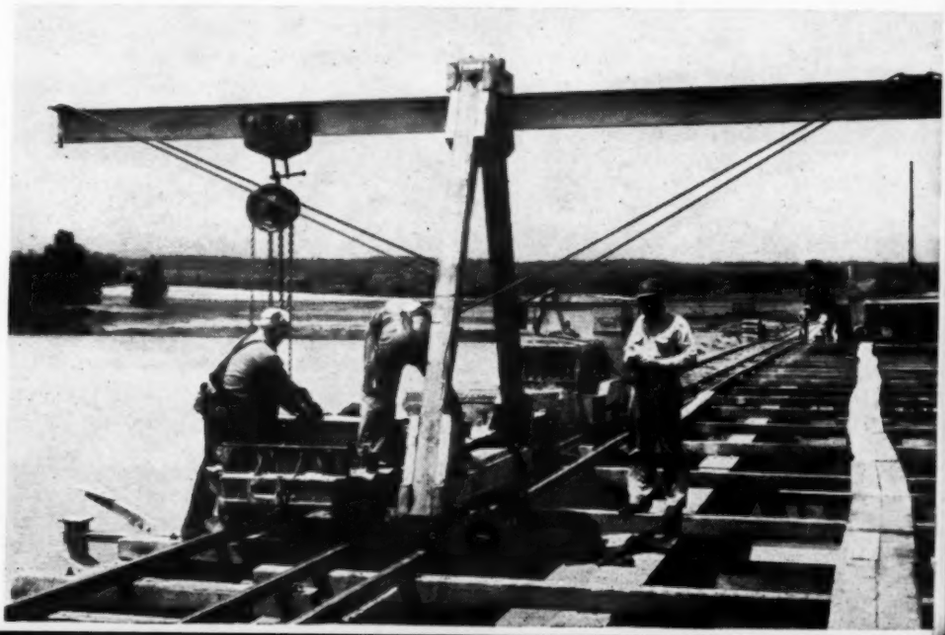


Photo by Sparlin

★ Angle-reinforced steel pier forms were fabricated for reuse on all piers of both bridges



★ Sidewalk brackets and other small steel was set from this traveler, using a chain hoist supplied by a gasoline locomotive

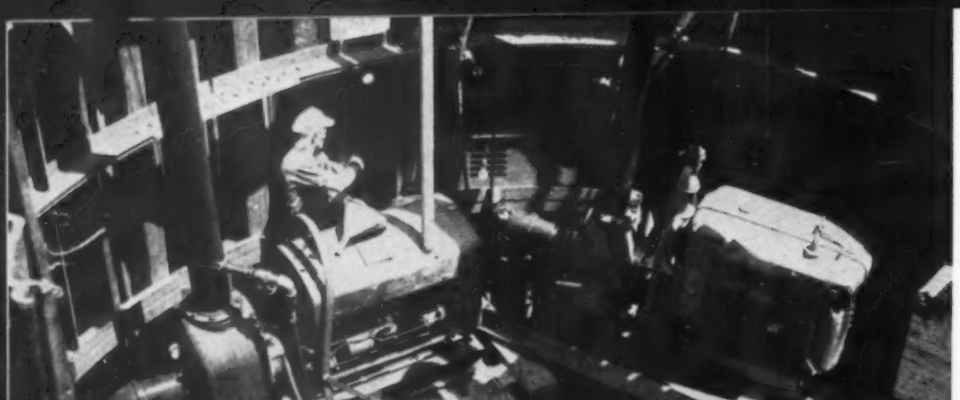
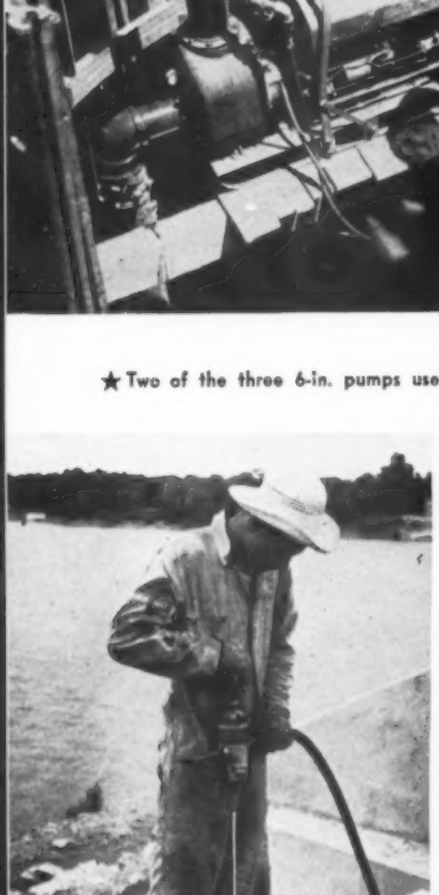
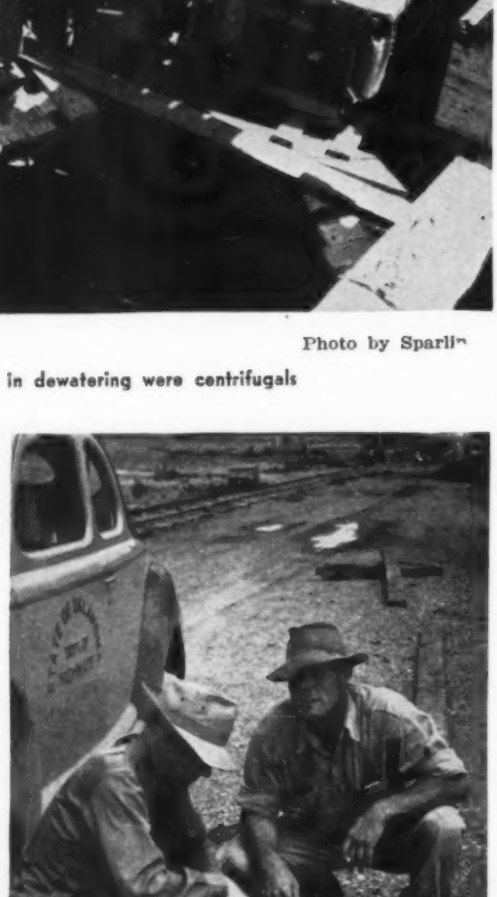


Photo by Sparlin

★ Two of the three 6-in. pumps used in dewatering were centrifugals





★ (Left): Electric power tool speeds up wood auger work in bolting dinkey ties to the deck. (Right): O. H. McLaughlin, project engineer and contractor superintendent, Ed Newman

★ Maid of all work—stiffleg handled concrete materials and form panels as well as structural steel

piling with great quantities of ordinary cinders. Cinders were delivered in burlap bags and the bags emptied in the water around the outside of the sheeting. The theory was that, being light, the cinders would remain in suspension in the water and particles would be sucked into the crevices and thus dam the leaks. This idea proved highly successful. About a carload of cinders was employed for each pier, and with the help of all these devices leakage was generally reduced to a trickle.

Two pier shafts on the Elk River job gave trouble, however. In one instance leakage persisted, and in order to meet the dry concreting specification for the footing, the footing was poured in a 11-ft. diameter canvas enclosure sewed together on the job.

The last pier to be concreted on this bridge also was a trouble maker. One of the pile sheets struck a fissure and went several feet father down than the rest, still without effecting a watertight footing. A wooden pile was driven into the fissure outside the ring, with little success, and then additional steel sheeting outside of that, to form a pocket for the cinders. This pocket was finally sealed by Tremie concrete. A six-inch "blow" pump, consisting of 54-ft. of pipe fitted with two air blasts near the bottom, was used to agitate and suck mud in connection with this difficulty.

Blasting in the Hole

Plans called for carrying concrete five feet below the rock surface. This meant blasting in the hole, since the rock was so hard that jackhammers had slow going after the first foot. The procedure in blasting was first to put down a sump hole, then drill a circular line of holes around the perimeter of the footing, after which a 5-ft. diameter area at a time was drilled and blasted, loading each hole lightly with about half a stick. No damage to the cofferdam was caused at any time.

Concreting Procedure

Shafts were concreted in four sets of steel forms, made up in half-circles and designed for easy unbolting. Tne 11-ft. diam. footing form was set and the 42-yd. pour completed in a day shift. The 8-ft. forms were immediately set and the 42-yd. additional pour finished the same day. Then the night crew set the forms for the 7-ft. section, which was concreted on the second day after which the crew laid off the pier for the rest of the day. On the second night, footing and 8-ft. forms were pulled, the key loosened

on the 7-in. forms, and the pumps pulled.

Steel forms were also used in topping out the pier after completion of the two shafts. Reinforcing for the wall was pre-assembled.

Concrete was delivered in a 1-yd. bottom dump bucket, from a concreting plant at one end of the bridge. This set-up was the same for each of the bridges, the plants each consisting of a one-yard stationary mixer mounted in a tower beneath the weighing hopper. Cement was delivered in bags up a belt incline from a storage house as shown in the accompanying photo. A single worker dumped the cement, operated the hopper and scales, and dumped concrete. Aggregate was clamshelled by a stiffleg on each job, the derrick rig being used to unload deck steel, steel forms and other heavy items from the trucks. Pier concrete was carried out on the bridge by a dinkey on one job and by trucks on the other.

Deck Forms Milled From Piling

Deck steel was erected by conventional methods. A small home-made traveller, with a chain hoist on a cross rail, proved to be a handy device for setting diaphragms, walk brackets and other connections.

In these days of lumber scarcity and high prices, it is noteworthy that the contractors were able to manufacture 40,000 board feet of one and two inch lumber for deck forms, by setting up a sawmill and cutting up falsework piling after use. This lumber cost the contractor about $40 per thousand, thus saving lumber cost as well as delay.

The decks of both bridges were concreted with a Pumpcrete outfit at a saving over other means of delivery. About 900 ft. and 400 ft. of 8-in. pipe were required, respectively. Concrete was placed in accordance with a loading diagram, calling for placing alternate 20-ft. panels in order to equalize weight on the continuous beams.

The two bridges are Federal-aid projects, designed and supervised by the Oklahoma state highway commission, H. E. Bailey, chief engineer, Homer X. White, bridge engineer, and J. J. Stobaugh, construction engineer. O. H. McLaughlin was resident engineer, under Joe Terry at the beginning and later E. J. Odell, division engineer at Tulsa. George Morgan was superintendent and Ed Newman engineer for Kansas City Bridge Company.

★ General view of the shorter of the bridges, showing pouring of alternate deck sections to counterbalance

New Bay Bridge for San Francisco Under Consideration

An investigation and report on the feasibility of a highway bridge over San Francisco Bay between San Francisco and Bay Farm Island are being made by a joint Army-Navy board. The board, set up under a congressional resolution (House resolution 529, by Rep. Welch of California), includes Brig. General G. H. Davidson, Col. Edwin H. Marks and Col. George Mayo for the army, and Commander Louis N. Moeller, Capt. F. C. Fluegel, and Captain James E. Baker for the navy. Public hearings are set for August 12 on the need for this proposed multi-million dollar structure.

The same need has been under investigation by the California department of public works, under a resolution passed by the California Tool Bridge Authority October 30, 1945. The public works department has since been engaged in preparing an exhaustive report, due for completion this calendar year. This study includes an analysis of traffic, an attempt to determine the most desirable location, and preliminary plan sketches indicating the type and character of bridge required.

The present structure has a saturation capacity of 80,000 vehicles daily, and at present traffic ranges 70,000 and upward. Studies indicate that the capacity of the bridge will soon be exceeded.

No attempt has been made thus far to publicly estimate the cost of the proposed bridge, which, however, would take its place alongside the present San Francisco Bay bridge as one of the world's great bridges. It is anticipated that the project would be financed by revenue bonds repaid through tolls.

N. Y. Committee on Wage and Hour Problems

Two committees have been established in New York state, according to public works superintendent Charles H. Sells, to bring about adjustments between federal and state wage differentials as they affect public work construction. Wage and hour problems have retarded public construction in New York, one of the chief problems arising from the state's constitutional limit of five eight-hour working days per week.

A committee on wage correlation will have as contractor representative Louis Mayersohn of Albany. A committee on the 40-hour week problem will be represented by contractors Anson B. Collins of Mechanicsville, and Stephen A. Scullen, of Cohoes, N.Y., along with labor and state government representatives.

Lights on Cinder Trucks

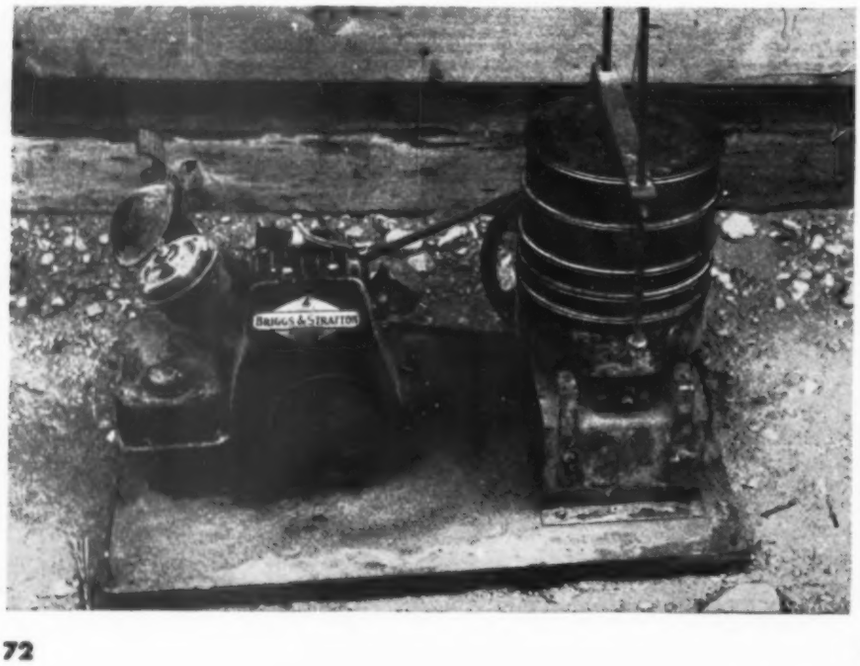
Night or twilight operation of sanding trucks in winter can be speeded up, and rendered more efficient and safe by installing a small shielded light over the dump body. This suggestion from an employee, Preston Gano, will be put into practice in New Jersey this winter, we note from a copy of the N.J. highway department's publication. The purpose of the light is to shine down on the bed and tailgate, to illuminate the work of sanding, without creating glare in the directions of traffic.

Nevada Highway Compaction Tests

THE Nevada state highway department has simplified its soil testing apparatus and soil testing procedure to about the limit of practicability. The equipment is light in weight and not bulky yet is very serviceable. The accompanying three photographs show the essential pieces of equipment which your Roads and Streets editors found in use on the Gibbons and Reed Company job as described in the March, 1946, issue.

Being familiar only with the proctor mold bolted to a stump or other convenient base, we were agreeably impressed by the ease of operation of the compaction cylinder and the rapidity with which final results are obtained. The instructions which the Nevada highway department issues to its field personnel follow:

★ Samples are easily reduced in size with very little likelihood of segregation by use of the quartering device shown. The sample is halved each time it passes through



★ The State of Nevada engineers have devised an easy-to-operate lightweight sieve shaker by the use of a small air-cooled gasoline engine

Method of Determining Relative Compaction of Soil

1. This method is for the purpose of determining the degree of campaction of soil embankments in order to arrive at their relative stability.

2. Representative samples of material to be tested are taken with an orchard post hole auger, soil tube, or other suitable equipment. In sampling of embankments, it will be found most convenient to take samples of material for each three or four foot layer as same is completed. The volume of test hole and dry weight of soil removed are obtained, from which the dry weight per cubic foot of soil as in place can be computed.

Very different kinds of soil such as sandy soil and clay may have somewhat low unit weights when compacted. These materials, however, when mixed together may have a dry weight per cubic foot compacted very much higher than either of the samples before mixing. Therefore, where various types of soil occur in different layers of an embankment each sample tested must consist of only one kind of soil. If, however, various strata are present in proposed excavation and borrow pits each sample must consist as nearly as possible of a mixture of the various kinds of soil in about the same proportion as they would be mixed in each layer or portion of the embankment.

3. A representative portion of the sample is compacted to a standard degree of compaction by the following method:

(a) For compacting soil in the field or laboratory, a sensitive 5 pound scale or balance and the soil compacting outfit, consisting of a cylinder fitted with a cap, tamping shaft, piston, soil auger and wrench are necessary.

In compacting soil by this method, sufficient dry soil is selected to fill

the compacting tube to a height of between 10 in. and 13 in. when soil is compacted as hereinafter specified. Five pounds of dry soil can usually be used, however, in light materials such as diatomaceous earth or shale a lesser amount will be required. This amount of dry soil is moistened, to a consistency which will give maximum compaction and compacted within the cylinder in five equal layers. Each layer is consolidated by dropping the tamping shaft 20 times through a height of 18 in. After compacting the fifth layer, the piston is placed within the cylinder and five similar blows of the tamping shaft applied. With the tamping shaft resting on the piston the indicated height of soil to the nearest 1/10 in. is read at a point level with the top of the tube from the figures indicated on the tamping shaft. The dry weight per cu. ft. of compacted soil is obtained from the attached table.

4. The relative compaction of soil in excavation or embankment is obtained by the formula $\frac{WP}{WC} \times 100$ where

WP = Dry Weight per cu. ft. in place, and

WC = Dry Weight per cu. ft. compacted.

WP dry weight per cu. ft. of soil in place is obtained by excavating a hole in the embankment or wherever the soil is in place. All the material from the excavation is carefully saved and weighed and the moisture content determined. Volume of the hole is determined by refilling with dry sand of which the weight per cu. ft. has been determined.

Field Soil Compacting Cylinder

Conversion metric to English units. 453.6 g. = 1 lb.

233.4404275 divided by the height of the compacted specimen (shown in Column 1) will give the corresponding factor to use in Column 2.

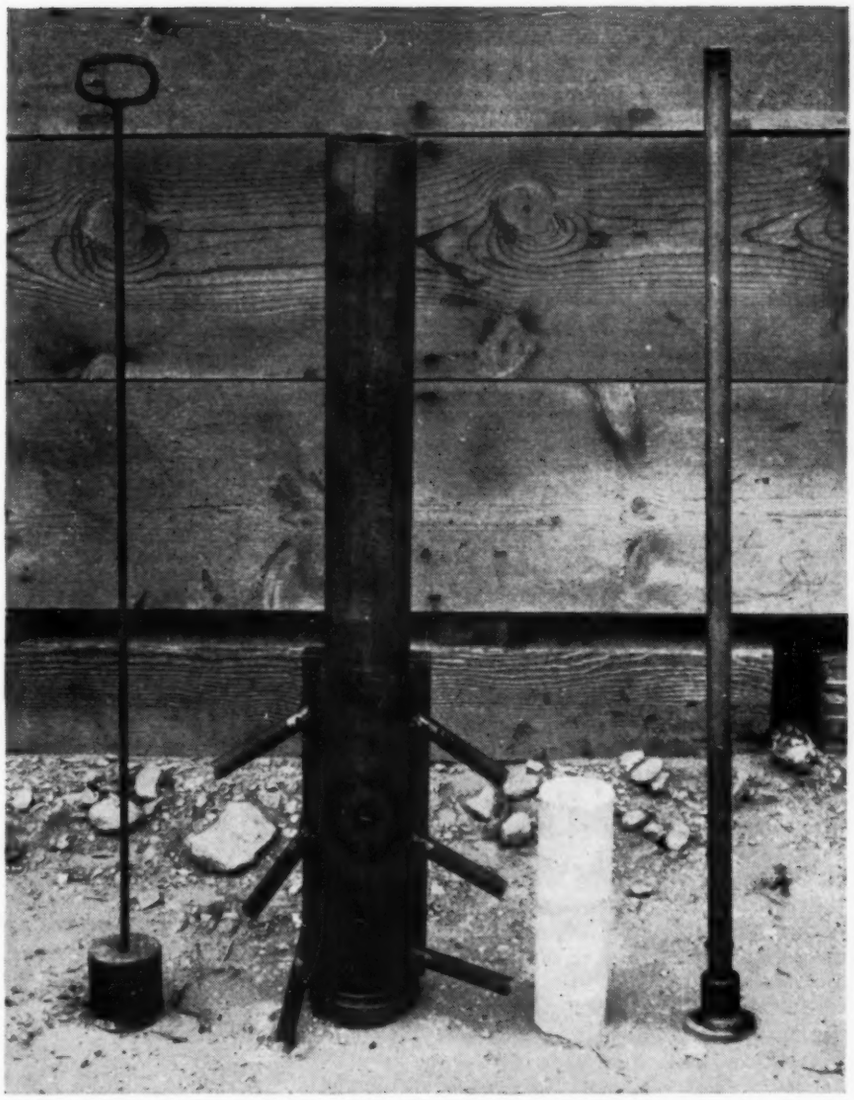
Diameter of Cylinder = 3.07 in.

Area of Cylinder = 7.402316 — sq. in.

Table for Finding Dry Weight per Cubic Foot

(Explanation of Columns: Column No. 1 gives the *net height* of the compacted specimen. Column 2 gives the corresponding factor for each value of Column 1. To find dry weight per cu. ft. multiply the factor in Column 2 by the dry weight of the sample used in making the compacted specimen. For example, assume 5.2 lbs. of dry soil is used to make a specimen

(*Continued on page* 125)



★ Soil compacting equipment and compacted sample. From left to right are shown piston with detachable plunger, tamping cylinder, compacted sample, and tamping shaft. Handle of tamping shaft is calibrated in increments of 1/10 in. so as to give a direct reading of height of sample while still in cylinder. Note the 5 layers

Net height of Compacted Specimen	Factor to be multiplied by wt. of sample	Wt. per cu. ft. for 3 lb. sample	Wt. per cu. ft. for 4 lb. sample	Wt. per cu. ft. for 5 lb. sample
7.0	33.34	100.02	133.3	166.70
.1	32.88	98.64	131.5	164.40
.2	32.42	97.27	129.7	162.10
.3	31.98	95.94	127.9	159.90
.4	31.55	94.65	126.2	157.75
.5	31.13	93.39	124.5	155.65
.6	30.72	92.16	122.9	153.60
.7	30.32	90.96	121.3	151.60
.8	29.93	89.79	119.7	149.65
.9	29.55	88.65	118.2	147.75
8.0	29.18	87.54	116.7	145.90
.1	28.82	86.46	115.3	144.10
.2	28.47	85.41	113.9	142.35
.3	28.13	84.39	112.5	140.65
.4	27.79	83.37	111.2	138.95
.5	27.46	82.38	109.8	137.30
.6	27.14	81.42	108.6	135.70
.7	26.83	80.49	107.3	134.15
.8	26.53	79.59	106.1	132.65
.9	26.23	78.69	104.9	131.15
9.0	25.94	77.82	103.8	129.70
.1	25.65	76.95	102.6	128.25
.2	25.37	76.11	101.5	126.85
.3	25.10	75.30	100.4	125.50
.4	24.83	74.49	99.3	124.15
.5	24.57	73.71	98.3	122.85
.6	24.32	72.96	97.3	121.60
.7	24.07	72.21	96.3	120.35
.8	23.82	71.46	95.3	119.10
.9	23.58	70.74	94.3	117.90
10.0	23.34	70.02	93.4	116.70
.1	23.11	69.33	92.4	115.55

EDITORIAL

★ The High Cost of Low Highway Salaries

By H. K. Glidden

Last winter during the American Road Builders' convention, we heard a great deal of talk about the current shortage of engineers, as well as the general admission that most state highway engineering personnel are underpaid. It was generally conceded that prevailing salaries offer little inducement to engineers in our colleges to make a career of highway engineering. Like most everyone, we were stirred up about this situation while the talking was going on. Since then, other matters which seemed to have a greater bearing on getting the highway program going, have claimed our attention.

While we feel that we cannot be criticized too severely for harping on construction cost, safety, inadequate budgets, and advanced planning, it was a rather rude awakening to hear a prominent highway official suggest a moratorium on highway lettings for the reason that his state does not have sufficient resident engineers, inspectors, instrument men, designers, and draftsmen to handle the work already contracted for. He went on to say that they were not receiving applications and that he took this as an indication that there just were not any men in these professions to be had. When asked about the steps the state was taking to provide intensified training of GIs and high school graduates to alleviate this situation, he told of a 12-week course for draftsmen being given by the state college. He added, ironically, that of the 15 men taking the training, he had no assurance that any of them would go to work for the highway department. It seems, further, that the school authorities cannot see eye to eye with him on his suggestion that the 12-week course be supplemented by other courses covering longer periods in order to meet the state's needs as further expansion takes place. This official stressed the need for intensified courses in all the various sub-professional phases of highway engineering. He expressed the opinion that, for instance, one year's intensive training would turn out instrument men much better qualiified to begin with than is the usual engineer after completing a four-year college course.

Thinking that it might be possible to recruit some help for him from among our friends in the engineering profession, we asked what the salary was for resident engineers. It was revealing, to say the least, to find that the scale ran from $225 to $325 per month, and that none of his residents were receiving top pay. Right then we knew we were not salesman enough to do him any good. You have got to be in love with your work nowadays to figure wages like that are any return on the investment one has to make to boast of being "Siwash Tech-'32." It is much better to claim three years pushing a bulldozer in the Seabees; anywhere from $75 to $125 per week is common for equipment operators and you don't have to take any of your work home with you nights. The union adds some other fancy attractions for the operators in localities where they are in control.

Our conversation brought out that very pertinent point, so completely overlooked by the officials who establish the engineer's pay scale. *The public* pays the operator's salary, just as surely as it does the salary of the "fellow who is living off of the state."

ROADS AND STREETS recently ran a series of articles on contractor-engineer relationships wherein the faults of the engineering profession, as well as some suggestions for improving their lot, were candidly discussed. Any such improvements from within the profession are bound to take time, but this thing is completely out of joint and the same public is paying the bill in the way of lives and health, needlessly sacrificed in accidents on our outmoded highways, high maintenance bills, delayed truck shipments, time lost through delays on congested highways, and in being deprived of pleasure while driving. The public needs to know what it costs them because of the niggardly salaries it pays its highway engineers. They need to be told again and again and in terms that they can understand with specific examples such as why a certain death trap continues to exist or any number of other things in which they are personally interested. Most of this education can be carried out only through the nation's widely read periodicals and newspapers. The cost to the public, because of the too frequent application of the spoil system in filling responsible highway positions, must also be stressed.

Getting back to last winter's meeting, we do not intend to criticize anyone, but we cannot help wondering how much spade work has resulted from all those good intentions. A large percentage of those of you who read this will be directly concerned with our state highway departments being staffed with competent engineers. All of you are influential. We, along with others, are going to keep reminding you, but we frankly do not expect much in the way of results until you get a better realization of the fact that you are part of the public and that poorly paid highway engineers probably cost each of you more than it does Joe Doakes. How about thinking it over and before you cool off, decide just what you personally can do to better the situation and then translate that decision into definite action.

★ Guard Rail Cheats Death

Driving around over the nation's highways we have gained the impression that there is a woeful lack of the use of properly designed modern cable guard railing. The importance of this highway safety feature was brought home to us very recently on a long steep stretch of mountain highway in Pennsylvania.

A short distance below the mountain summit, skid marks on the pavement told plainly a story which might well have ended in tragedy but for a strong resilient rail. The driver had apparently applied the brakes suddenly and with full force as the tires had burned their imprint into the pavement. Whatever the emergency was, brakes alone were not enough and the tracks started to weave and soon left the pavement on the right hand side veering toward an almost precipice-like drop. Then the guard rail came into view, two or three posts missing, but the cable intact. It seemed almost incomprehensible that the skid marks

should again show up on the pavement and in a short distance dissipate into nothingness as the driver had regained control. More amazing was the size of the truck trailer at the bottom of the grade, battered up some, but not bloody or seared by fire.

It was a good feeling a few days later to receive from the New York State Department of Public Works a news-release announcing the award of a contract for 3¾ miles of guard rail on a 5.77 mile project. We drive a lot in that state and it is very possible we can use some of their rail one day.

We firmly believe that the engineers and public officials involved will have been derelict in their duty if we do not receive many more such notices from New York and from all the other states. We liked the news release so much we want to quote part of it for you.

". . . Included in the work, which will cost $34,100, will be the removal of the existing, outmoded, rustic timber guide railing and the setting of approximately 100 guide posts in addition to the standard cable type which constitutes the greater part of the project. All work is scheduled for completion by Oct. 1.

"The cable guide railings will be established at sections along both sides of the highway where protection is required. The most modern type is specified, consisting of four strands of three-quarter-inch diameter steel wire cables secured to posts made of sections of steel railroad rails. These posts are to be driven securely into the ground after which special spring steel fittings are attached to hold the cables. The cables will be stretched and securely anchored into the ground at the ends of each section."

★ Let's Consider Compaction

In our opinion there are at least three things remaining to be accomplished before soil compaction can ever receive the universal acceptance to which we feel it is entitled. The editors of ROADS AND STREETS are convinced that compaction of pavement subgrades pays very high dividends. We have seen proper compaction of subgrades result in lower maintenance costs, smoother riding pavements, greater load carrying capacity for a given pavement section, and in more uniform results where the same design criteria are used over a large geographical area. High fills can thereby be paved without any appreciable waiting period and without fear of a miniature roller coaster resulting. Our observations lead us to believe that wherever we have encountered a group of engineers who have delved into the reasons for compaction, and who have thereafter adopted reasonable specifications and put into effect fair and reliable inspection practices, we have almost invariably encountered a group who also perform all phases of its engineering in an efficient and respected manner. On the other hand we see a great deal of lip service rendered compaction by some agencies with the actual on-the-job results no different than they were fifteen years ago.

No. 1 on our list of things to be done is the carrying out of a nationwide selling program designed to convert a high percentage of our engineers to the same belief and faith in the merits of compaction which has been attained by nearly everyone who has been properly enlightened. The educational program must extend to the contractors somehow, for it is well known that compliance with little-respected specification requirements is almost impossible to attain. It is equally important that it reach the field forces, the men who actually pass judgment on the quality of the finished work. We have seen several instances where the best of intentions on the part of far-sighted engineers in administrative positions have been completely nullified by the honest belief on the part of field personnel that compaction tests and specifications were just something some long-haired scientist had sold the boss in one of his weak moments.

The splendid efforts of the various national agencies to promote compaction has so far produced fine results, particularly in the development of techniques and procedures for both rolling and testing. We would like to suggest that each of these agencies, as well as those whose scope is more sectional, give consideration to the need for such a sales program as will give compaction the same standing as has been achieved by other relatively newcomers such as the slump test for concrete and stripping tests for asphalt.

Citing examples of the good results obtained on specific projects, describing construction practices or uses of equipment which have made compaction easier to attain, airing specification faults, reporting on testing procedures applicable to unusual soil conditions, and stories tending to remove the mystery from the subject can hardly help but arouse interest and at the same time demonstrate the dollar and cents value of securing good compaction. We intend to follow out our own suggestion by bringing you our own experiences and those of the contractors and engineers with whom we come in contact.

No. 2 on our list deals with the competency of the individual who will actually perform the compaction tests in the field and who will therefore exercise immense power over the contractor and the thousands of dollars worth of equipment he has on the job. We find that many a contractor who personally believes in good compaction is scared to death of it for fear that he will be placed at the mercy of a poorly paid inspector who has been subjected to an intensified course in soils mechanics, given a bunch of gadgets and who thereafter feels that he must find something wrong occasionally in order to lend dignity to his new position. Some of these same contractors have let it be known that they are thinking seriously of employing their own soils engineer in order to protect themselves against any abuse which can come about through ignorance or malicious intent in the performance of the tests involved. The contractor must have reason to be confident in the accuracy and fairness of compaction tests. The same thing holds true for the resident engineer on the job. To accomplish this end, the soils inspection position is going to have to be set up on a high level, be well paid, and be filled by an individual whose experience and background are such that his judgment will carry weight regardless of the test results. The scope of the soil testing organization on a grading project will vary with the size of the job and the manner in which the grading operations are conducted. Technicians fresh out of school may well have a place in such an organization, but heaven forbid that they be given the authority and responsibility which should go with the soils inspection job. We have seen it happen where in such an instance both the contractor and the resident engineer regarded the soils man as a necessary evil and treated him as such. The public officials who are charged with the responsibility of setting up soils inspection positions and selecting the personnel will do well to remember that it is universally true that you cannot get anything for nothing and that you usually get just what you pay for. When compaction requirements are placed in the specifications, the public is immediately going to have to pay for compaction whether it gets it or not, because the contractor is going to include its cost

(*Continued on page* 99)

Texas Claims Honors for First Completed F. A. Secondary Project

19.8-mile job in Texas Panhandle completed in 33 working days; caliche base with single asphalt seal; Bell and Braden of Amarillo contractors

THE Texas highway department has perhaps the most extensive farm-to-market highway program of any state, and was well advanced in working out the details of the program and selling it to the public when the Federal Highway Act of 1944 was passed [See June, 1945 "Roads and Streets"]. The Texas annual $20 million program (half state and half federal) for first 3 postwar years is nearly twice that of any other state. Pennsylvania is second in size of secondary program allotments.

No one is surprised, hence, when the Texans stepped forth in May this year and claimed a significant "First" in actual project completion under the Secondary phase of that act. The job in question is a 19.8 mile section in Randall and Armstrong counties, tapping U. S. 87 into Amarillo. Typical of thousands of miles of Texas secondary roads, it serves a prosperous grain and cattle ranch area, yet was still in the unimproved dirt stage.

The old road was about 16 ft. wide and followed the natural contours. The improvement, designed to cost around $6,000 a mile under present conditions of inflation, consisted of widening the right of way from 50 to 80 ft. minimum, cutting new ditches and shaping to a 24-ft. crown, grading shallow cuts and fills in the rolling terrain, applying 5 in. of crushed caliche base, and priming and sealing. The total contract cost was $123,205.

The entire job took only two months elapsed time from beginning to acceptance, and only 33 working days. Contract allowed 120 working days. About two-thirds of the stations were graded entirely with motor graders, the work being simply a heavy ditching and crowning operation. A fleet of large self-powered scrapers dispatched the rest, for a total of about 30,000 cu. yd. of excavation. Bell and Braden, of Amarillo, the contractors, had other projects and were only too glad to get through and gone with their scrapers. No formal compaction of the grade was required.

Crushed, screened caliche, graded to 2 in. max., was quarried at two points along the project, using a large semi-portable outfit. The 40,350 sq. yd. of base was spread 16 ft. wide and rolled with pneumatic rollers.

Topping was also 16 ft. wide. The base was first primed with 0.3 gal, of MC-1, and a single asphalt surface treatment applied consisting of 0.35 gallons of OA-230 covered with chips spread one cubic yard per each 80 sq. yards of surface. Asphalt was delivered to a nearby point in tank cars and handled with a single distributor and two booster tanks.

Only one small bridge structure was needed on the project. Corrugated iron pipe and concrete pipe culverts were installed for smaller openings.

Many farmers and ranchers along the way decided they wanted similar construction on the roads in from their gates. A considerable mileage of narrow caliche-asphalt roadway was constructed by the contractor under private deals.

Large Airports Require Change in Federal Act

Construction of Class IV and larger airports with federal funds will be impossible in the 1947 fiscal year, unless action is taken to change the provisions of the Federal Airport Act which became a law on May 13, Walter R. Macatee, manager of the airport division of the American Road Builders' Association, has pointed out. Under the act, the administrator of the Civil Aeronautics Administration must ask Congress for authority to begin development of the larger type airports sixty days before the close of each fiscal year which is June 30, or less than two months since the act was approved.

However, Mr. Macatee points out that under the terms of H.R. 6741 introduced by Representative Bulwinkle of North Carolina, relief of this situation will be provided when Congress and the President approve the bill, the terms of which make an exception whereby the administrator will not be required to submit such a list during the present fiscal year. Thereafter the terms of the original bill again become operative.

This bill making an exception to the original act has been favorably reported by the Committee on Interstate and Foreign Commerce, and has passed the House. No serious opposition is anticipated for it in the Senate.

Class IV and larger airports are those which serve metropolitan centers and any delay in their construction would create an unbalanced condition in development of the National Airport Plan.

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On the State legislative front, according to a bulletin from the National Highway Users Conference, Missouri S. 487 increasing length of tractor-semi-trailers from 45 to 50 ft., that of other combinations from 45 to 60 ft. and providing gross weight in accordance with American Association of State Highway Officials' recommendations, passed Senate. Louisiana S. 262, also increasing length in accordance with AASHO's recommendations, is reported to have been approved by the Governor. This measure also provides that gross tandem axles spaced less than 8 ft. apart shall not exceed 32,000 lb. and those 8 ft. or more apart, 36,000 lb.

Picture of the month

To engineers of the California Division of Highways and of western contracting organizations go the credit for what you see in this picture. Symbolizing the scientific research and practical ingenuity through which the American public will be given billions of dollars worth of new highways and streets and runways, this photograph depicts a major development in soils and foundation engineering; the use of sand drains to hasten settlement of unstable, high-water-table areas under fills and to control lateral ground movement and bulges adjoining fills over such ground. Nearly 10,000 holes 15 to 22 inches in diameter are being jetted some fifty feet into the ground this summer on several adjoining contracts for sections of Terminal Island Freeway, which will help link Los Angeles with its harbor area. Macco Construction Company is the contractor on the work shown here. Watch for the details in the next issue of "Roads and Streets."

JOB and EQUIPMENT IDEAS

Send in your contributions to this idea exchange and help road building progress. ROADS AND STREETS will pay a minimum of $10.00 each for any publishable field or office methods or shop kinks. Why not pass this along to your staff and encourage them to send in brief "how we did it" descriptions, rough sketches or snapshots.

Grade Uphill? Tain't Worth It

Almost every contractor knows the value of loading and dumping earthmoving equipment in such a way as to take advantage of a downhill drag. Saves power, makes it easier on equipment, speeds up the job, etc., etc. And of course smooth haul roads, have the same effect.

The importance of grade and rolling resistance as factors in efficient earthmoving are analyzed in the following data from R. G. LeTourneau, Inc.:

Rolling resistance can offset grade considerations, or it may be additive and require an even greater amount of drawbar.

The following formula can be used to calculate grade ability in conjunction with roadway rolling resistance:

$$GA = \left(\frac{TE}{GVW} - \frac{U}{T}\right) \times 100, \text{ in which}$$

GA = Grade ability in percent,
TE = Tractive effort or drawbar pull in pounds,
GVW = Gross vehicle weight in pounds,
U = Selected rolling resistance in pounds,
T = 2,000 lbs. (1 ton)

Table of Typical Rolling Resistances (U)

Hard-packed, smooth road, no penetration	40 lb.
Good construction road, well maintained	65 lb.
Average construction roadway	100 lb.
Moist sand	200 lb.
Dry sand	300 lb.

For example:

Tractor weight	= 34,000 lb.
Scraper weight	= 30,000 lb.
Dirt weight	= 36,000 lb.
Gross vehicle weight (GVW)	= 100,000 lb.
U	= 40 lb.
TE	= 26,000 lb. in first gear at 1.6 m.p.h.

Then,

$$GA = \left(\frac{26{,}000}{100{,}000} - \frac{40}{2{,}000}\right) \times 100$$

$$= (.26 - .02) \times 100$$
$$= 24 \text{ per cent}$$

Hence, a 34,000-lb. tractor in first year at 1.6 m.p.h. can pull a trailed load of 66,000 lb. up a 24 per cent grade on a good roadbed.

Scraper weights and capacities, as well as drawbar pull and speed, can be obtained from specification sheets for use in determining any specific haul problem. By transposing the formula and working backwards, it is possible to obtain necessary drawbar and speed.

Taking the problem already stated as an example, with the same information given except for drawbar, how would one determine the gear, drawbar and speed?

Solution:

$$GA = \left(\frac{TE}{GVW} - \frac{U}{T}\right) \times 100$$

$$TE = \times GVW$$

$$= \left(\frac{24}{100} + \frac{40}{2{,}000}\right) \times 100{,}000$$

$$= (.24 + .02) \times 100{,}000$$
$$= 26{,}000 \text{ lb. drawbar}$$

With the required drawbar thus determined, the next step is to go to the specification sheet for the tractor to be used and find: (1) What gear provides the required drawbar

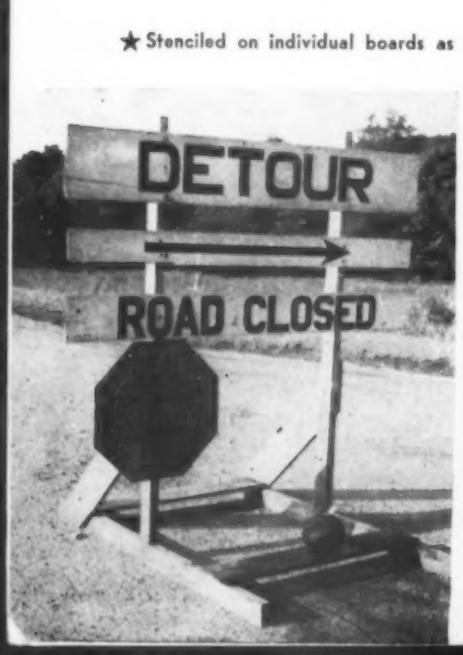
(See opposite page)

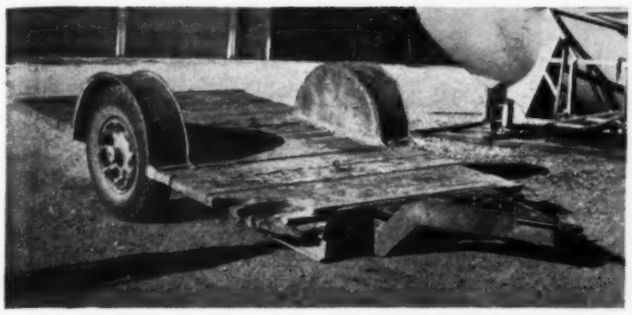
Stencilled Sign Saves Lumber

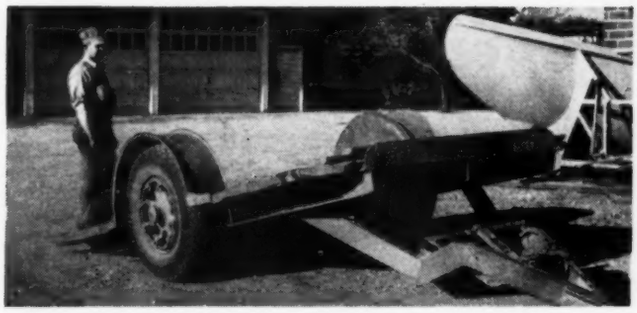
Francis Cunningham, Warren Bros. Roads Company superintendent, is using a novel idea in highway sign construction. Mr. Cunningham says that he adopted the idea after seeing similar signs in the town of Salamanca, New York, near his present assignment, which consists of re-surfacing and widening 19 miles of highways in New York State's Allegheny Park.

The accompanying photographs show the details of construction of two of the signs erected on this project. It is easy to note that a minimum of lumber is used and that the signs can be erected at a nominal cost. In pointing out the advantages of this type of sign, Mr. Cunningham called attention to the fact that the lettering on each board can be stenciled and that the spacing of the boards allows the wind to exert only a minimum amount of strain on the sign. The transportation and erection costs of this type of sign are small compared to the usual type of sign where the wording is lettered on a solidly sheeted frame.

★ Stenciled on individual boards as seen on Warren Bros. job

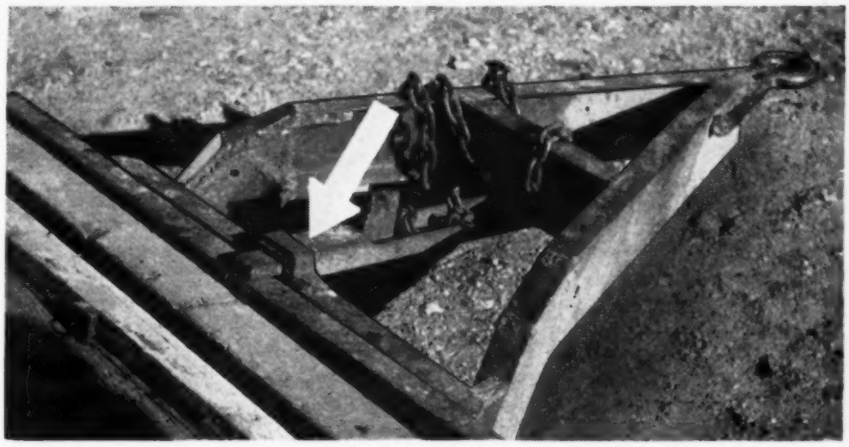






Teeter-Totter Trailer Useful to This County

A low-bed trailer which is so designed that the back end of its bed can be dropped to the ground without unhitching the unit, is among the interesting pieces of labor-saving equipment built in the Cerro Gordo County maintenance shop at Mason City, Iowa. As shown in the accompanying photos, the trailer bed is not fastened rigidly to the towing frame, but the frame is connected by means of a pin joint just in front of the axle. By pulling out a pin and sliding a latch bar (see arrow) the bed is permitted to tip upward, in front, which it will do readily when a worker steps on the back end. The trailer is especially useful to this county for unloading stumps and other objects which can be made thus to roll or tip off by merely tripping the latch. Conversely, when the bed is tipped to the ground it is easy for the truck operator to slide heavy objects onto the trailer unaided with a truck winch. R. E. Robertson is county engineer of Cerro Gordo County.



(*Continued from page* 78)

and (2) what is the speed for this gear. If the drawbar falls between two gears, the lower gear must be used. As a practical illustration, it may be found that the tractor to be used has only 25,000 lb. drawbar. In this case it will be necessary either to carry smaller pay loads or to cut down the grade.

As another example, the tractor may lack just a few pounds of the drawbar necessary for running in highest gear, and as a result it may have to travel in fifth gear at 3.6 m.p.h. instead of sixth gear at 4.9 m.p.h. If the yardage warrants, it may be profitable to cut down the grade to permit traveling in sixth gear. Thus, either the cycle time could be reduced, or additional distance could be traveled.

In the next issue, Ken Park winds up his series of articles on earthmoving with some yardage-boosting ideas on Pusher Efficiency.

Effective Hand-Operated Stone Spreader

C. J. Langenfelder & Son, Baltimore contractors, have found it expedient to supplement their mechanical stone spreaders with a simple hand-operated tool which allows accurate spreading of stone in locations hard to reach or which involve difficulties for stone spreader operation.

Fig. 1 shows a close-up of the connecting end of the tool. The tool shown in the accompanying photographs has a 1½ in. diameter pipe handle, but an ordinary 2x4 will prove equally satisfactory. The strap iron part of the tool which hooks over the top of the dump-truck end gate is fastened to the handle about 30 in. back from the end. The distance from the handle to the fastener is usually about 18 or 20 in. but will vary according to the dimensions of the end gate.

Fig. 2 shows a close-up of the tool attached to a truck while Fig. 3 shows a workman operating the tool.

★ Figure 1

★ Figure 2

★ Figure 3

New Jersey Steps Out

With Unprecedented Freeway and Parkway Program

Farm-to-market roads also included; but spotlight is on bold plans for streamlining huge traffic flow in metropolitan areas. $45,000,000 available for this year. Freeway studies involve economic analysis and estimate of unit-lane capacities

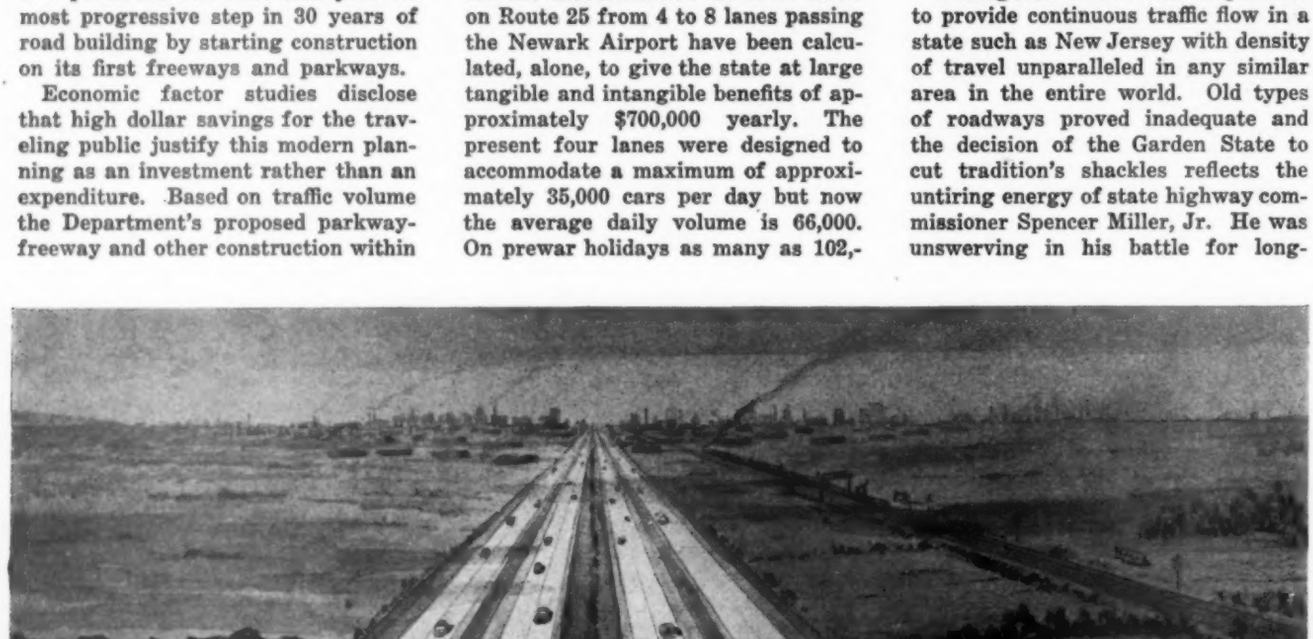
By H. K. Glidden
Eastern Editor, Roads and Streets

NEW JERSEY'S state highway department will take this year its most progressive step in 30 years of road building by starting construction on its first freeways and parkways.

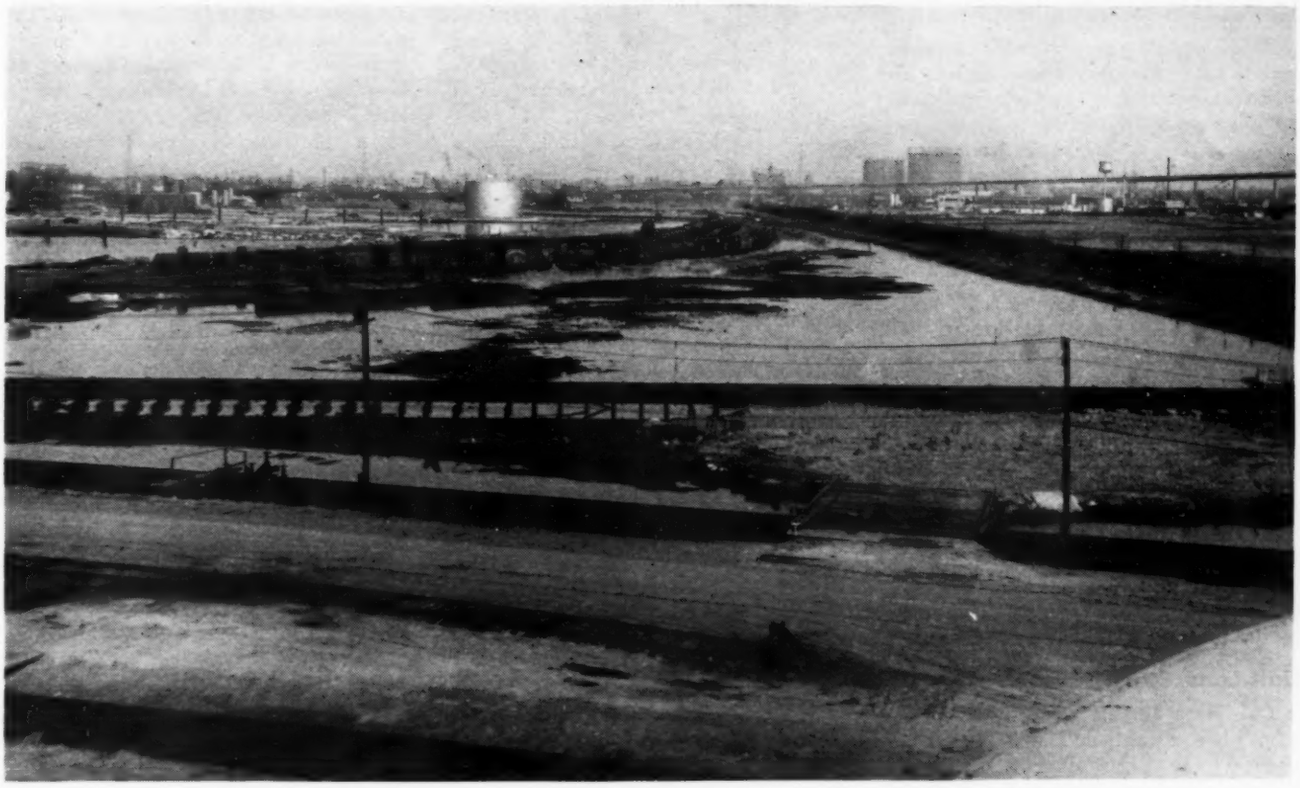
Economic factor studies disclose that high dollar savings for the traveling public justify this modern planning as an investment rather than an expenditure. Based on traffic volume the Department's proposed parkway-freeway and other construction within the next 18 months will represent a return of as much as $5 for every $1 appropriated.

In fact, contracts recently awarded for the modernization of three miles on Route 25 from 4 to 8 lanes passing the Newark Airport have been calculated, alone, to give the state at large tangible and intangible benefits of approximately $700,000 yearly. The present four lanes were designed to accommodate a maximum of approximately 35,000 cars per day but now the average daily volume is 66,000. On prewar holidays as many as 102,000 automobiles per day have converged on this bottleneck to finally get through only after enervating stops in stalled lines.

Courageous action was imperative to provide continuous traffic flow in a state such as New Jersey with density of travel unparalleled in any similar area in the entire world. Old types of roadways proved inadequate and the decision of the Garden State to cut tradition's shackles reflects the untiring energy of state highway commissioner Spencer Miller, Jr. He was unswerving in his battle for long-



★ Airplane view of proposed state highway route 100



★ Freeways, such as New Jersey's proposed Route 100, can cost $5,000,000 per mile in areas such as this where right of way runs as high as $3,000,000 per mile

sought modern transportation facilities.

To Charles M. Noble, his newly appointed state highway engineer, he has delegated now the problem of making feasible parkway and freeway plans blending utility with scenic attractiveness. Recently completing his duty as Commander in the Seabees, Mr. Noble has been chosen to carry on in the face of obstacles that exist in developed residential and industrial areas. His task will be to build new arteries convenient for localities which are now fettered by street blockades.

To Relieve Congestion

It is due to money limitations as well as the pressing need in hampered municipalities that initial sections of both parkway and freeway will be limited to populous districts. Overtaxed arteries with continuous congestion have decreased their hauling costs and with inevitable property depreciation through inaccessibility.

Future years are to bring extensions north and south as well as east to west. The goal is to promote the further development of New Jersey from border to border—from mountain lakes in the north to seacoast resorts at Cape May's southern tip.

Fight for Legislation

Agitation for adequate roads had been carried on intermittently for a decade but it was not until this year that legislation was enacted to permit limited access state routes. Governor Walter E. Edge supported the proposal. The signing of the statutes was made memorable through the presence of large civic organization delegations whose enthusiasm was marked by spontaneous applause when the executive remarked:

"By our action today we take another step to restore New Jersey to its rightful position of leadership as 'the good roads state'."

Commissioner Miller voiced his gratification in the comment:

"We shall now be able to begin the building of more attractive roads—parkways with landscaped borders, limited to passenger vehicles, and freeways open to all types of vehicles but barring encroachments of unsightly shacks."

TABLE I
HIGHWAY CAPACITIES
NO CROSS TRAFFIC AND LIMITED ACCESS
NEW JERSEY CONDITIONS

CLASS OF HIGHWAY	LANE CAPACITIES PER HOUR				*ONE DIRECTION CAPACITY PER HOUR		*ONE DIRECTION CAPACITY PER DAY ASSUMING MAXIMUM HOUR IS 12% OF TOTAL	
	Saturation 5 mins. lost per car per mile	Tolerable Maximum 1 min. lost per car per mile	Satisfactory Maximum 12 secs. lost per car per mile	Desirable Maximum No lost time	Satisfactory Maximum 12 secs. lost per car per mile	Desirable Maximum No lost time	Satisfactory Maximum 12 secs. lost per car per mile	Desirable Maximum No lost time
2 LANE (TWO-WAY)	1200	1000	750	500	750	500	6250	4440
4 LANE (UNDIVIDED)	1550	1000	825	650	1650	1300	13750	10830
4 LANE DUAL	1550	1300	975	650	1950	1300	16080	10830
6 LANE DUAL	1300	1067	800	533	2400	1600	20000	13330
8 LANE DUAL-DUAL	1550	1300	975	650	3900	2600	32500	21660
12 LANE DUAL-DUAL	1300	1067	800	533	4800	3200	40000	26660

*THESE FIGURES CANNOT ALWAYS BE MULTIPLIED BY 2 TO ARRIVE AT TOTAL HIGHWAY CAPACITY BECAUSE DISPROPORTIONATE DIRECTIONAL FLOW OCCURS UNDER CERTAIN CONDITIONS.

NOTE: IF TOLERABLE MAXIMUM IS EXCEEDED 10 TIMES PER YEAR OR SATISFACTORY MAXIMUM IS EXCEEDED 30 TIMES PER YEAR, THE HIGHWAY IS INADEQUATE AND A NEW FACILITY IS REQUIRED.

Northern Metropolitan Area

Special statutes designate traffic relief first for metropolitan North Jersey, especially in the area bordered on the east by the Passaic River; on the west by the Orange Mountains and extending from Paterson southerly to the Raritan River in Middlesex County.

Although there are only five miles between this East-West boundary, it contains the homes of more than one-third of the state's population of 4,160,165. Many of these residents are subjected to tie-ups on a single north-south roadway where the travel volume exceeds 100,000 vehicles per day. Limited access highways with entrance and exit at regulated distances and free of stop-go lights are needed to get them to and from their employment in reasonable time.

The alternative is continued depreciation in property values and vacant stores in their business districts.

Unit-Lane Capacities Established

The New Jersey highway department has established unit-lane capacities for highways of different classifications and has conducted studies and observations over a period of years in order to set up practical values for planning and design purposes. The aim is to construct a facility of sufficient capacity to serve the volume of traffic that highway planning surveys indicate will use the facility initially and for a reasonable period in the future, as for example, twenty-five years. These capacity studies have indicated that it is not desirable to set up one absolute set of values, but that it is preferable to classify capacities into several groups based on time losses per mile per vehicle. These groupings and values, as evolved by W. R. Bellis of the state highway department, are the basis for establishing the required capacity of the highway transportation system in New Jersey. The groupings are: (1) Undesirable Capacity (Saturation); (2) Maximum Tolerable Capacity; (3) Satisfactory Maximum Capacity, and (4) Desirable Maximum Capacity. These groupings and lane capacities for the different classes of highways are shown in Table 1.

It is noted that when the tolerable maximum capacity of a roadway is exceeded 10 times per year or the satisfactory capacity is exceeded 30 times per year the highway is inadequate and a new facility is required to serve the traffic effectively.

High Tax Ratable Loss Preventable

State highway engineer Noble, speaking at the spring meeting of the American Society of Civil Engineers in Philadelphia this year, made the following statement regarding the loss in tax ratables:

"There are two principal cost elements involved in providing new traffic facilities in metropolitan areas; (a) real estate and construction costs, and (b) the loss in tax ratables to the state, county and local governmental sub-divisions.

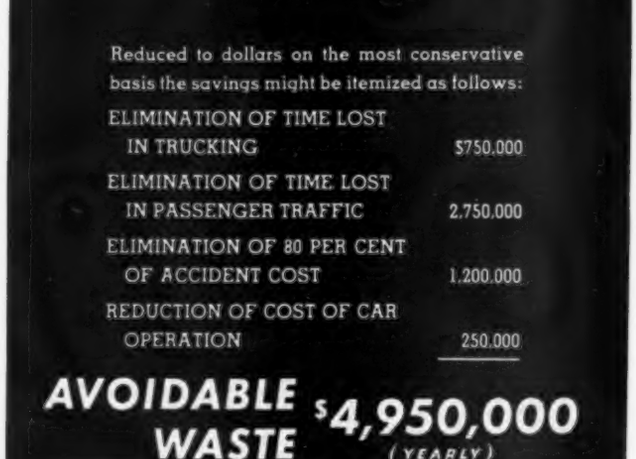
"It is the latter cost; namely, loss in ratables, which appears at this moment to present the greatest stumbling block in the path of the rapid construction of traffic relief facilities in Metropolitan New Jersey. This is particularly true in those urban areas which are made up of a succession of small boroughs or towns. When large areas are built up solidly for many square miles, a projected highway route may cut through several communities and the construction might destroy a sizable part of the total ratables in each community. This condition may be contrasted with the case where a traffic relief artery is constructed through a single large city.

"In this case it is generally possible to select a location through a continuous blighted belt. Although the same acreage of land is utilized as for a corresponding distance through a series of small communities, the proportionate loss in ratables is very much less for the larger city, and may be more readily absorbed without financial distress during the interim period required to restore the tax values in the blighted areas that will be brought about because of the improvement and relief from traffic congestion. There is no such cushion in the smaller communities to take up the shocks, and the officials and citizens in towns in the path of through traffic relief arteries are most apprehensive over the loss of ratables and consequently often oppose the proposed improvement.

Improvement Districts a Solution

"As a solution to this impasse it may be desirable to view an urban area made up of several small communities as a large single tax area, insofar as the loss of tax ratables due to the construction of through traffic arteries affects county and state taxes. This is exactly what would occur if these communities were part of a single large city instead of separate political sub-divisions. If a community through which a trunk artery is projected were offered forgiveness of a substantial portion of state and county taxes for a period of years (the forgiven portion being assumed by the other communities in the above mentioned tax area), it is believed

75% of the congestion in New Jersey
is in the area served by 21 miles
of Highway 25
When built this highway was planned to accommodate 36,000 cars a day
Today's average is 66,000
Today's high is 102,000


(THIS RELATES TO THE 21-MILE SECTION)
Reduced to dollars on the most conservative basis the savings might be itemized as follows:
ELIMINATION OF TIME LOST IN TRUCKING $750,000
ELIMINATION OF TIME LOST IN PASSENGER TRAFFIC 2,750,000
ELIMINATION OF 80 PER CENT OF ACCIDENT COST 1,200,000
REDUCTION OF COST OF CAR OPERATION 250,000
AVOIDABLE WASTE $4,950,000 (YEARLY)

★ In its fight for legislation and favorable publicity, New Jersey makes use of geographic illustrations

that it would relieve the small community of a severe financial strain and would be a sufficient inducement to remove the opposition to highway improvements in built-up areas. This plan could be administered similarly to an Improvement District where assessments are made in ratio to benefits and would apply only to loss in ratables occasioned by *limited access* type highways, inasmuch as a land service improvement would compensate the affected town for loss in ratables immediately. It is believed this is a fertile field for engineers, administrators and legislators and that constructive work can be done which will affect favorably the development of modern highway transportation facilities in metropolitan areas."

Route 4 Parkway

The Parkway, Route 4, has been legislated to begin at Route 6 in Clifton, Passaic County, and continue in a general southerly direction through Essex County; Union Township in Union County; Cranford, Clark Township and Woodbridge Township, Middlesex County, to Cape May; with a branch from Woodbridge to Trenton.

The first contracts will be principally for grading, drainage, and minor bridges on the 11 miles from Woodbridge, to the Essex-Union County line.

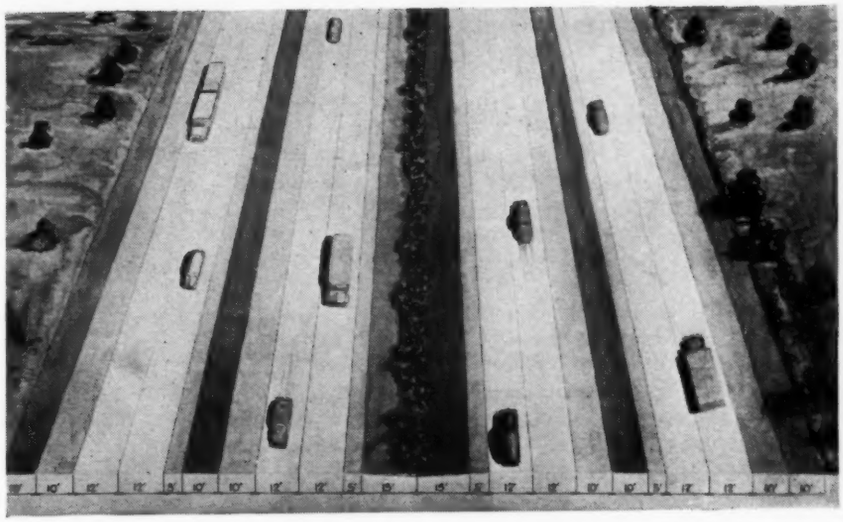
Extension of the parkway system eventually from the New York State line, with access to the George Washington Bridge at Fort Lee, to Cape May, remains for subsequent years. Future events will also control branches to Trenton and Camden from Woodbridge; a freeway to the State of Delaware-Salem County bridge proposed to span the Delaware River; and a parkway from New Brunswick to connect a Delaware River crossing north of Trenton.

Route 100 Freeway

The Route 100 freeway is to begin at the George Washington Bridge in Fort Lee continue to Middlesex County, passing in the vicinity of Ridgefield, Bergen County; North Bergen, Hudson County; Newark, Elizabeth and Woodbridge, with a branch from Elizabeth crossing Newark Bay to Bayonne.

It will serve the Lincoln and Holland Tunnels and the George Washington Bridge crossings of the Hudson River to New York.

The 16 miles from near Bonhamtown, Middlesex County, to the Essex-Union line at Elizabeth have been included in approved appropriations and the alignment has been adopted for the Bonhamtown - Woodbridge six miles in Middlesex County.



★ Dimensions and layout of proposed "Dual-Dual Highway" designed to maintain its traffic efficiency forever

Divide Construction Sections

To allow of greater competition among contractors and to permit of more rapid construction the plan is to have the parkway and freeway built under separate contracts at approximately $1,000,000 each. This arrangement in the course of the next three years will require about 18 contracts for Route 100 and about the same number on the Route 4 parkway.

Features for Safety

In New Jersey's design for parkways and freeways it is intended to include the most advanced safety and efficient traffic provisions. Some of these may be summarized as follows:

Entrance and exit at predetermined places with adequate night lighting.

No grade crossings at intersecting roads and railroads or drawbridges over navigable streams.

No crossings of pedestrians at grade.

Center safety island or median strip to separate opposing lines of traffic.

Wide, paved shoulders.

Acceleration and deceleration lanes at traffic interchange points.

Normal minimum radius of 6,000 ft. at curves and maximum gradients approximating 3% on through lanes.

Ample sight distance for safe travel.

Direction signs — readily visible from a moving vehicle and illuminated at night.

300 ft. normal right-of-way width to permit landscaping with preservation of natural scenery.

General Need for Traffic Relief

Although New Jersey ranks 45th in area among the states with its 7,836 square miles, it has ninth position in population. This density in development, accordingly, presents factors in road building not encountered in great open space states.

Construction costs mount in proportion, when comparison is made also with states sparsely settled and not required to have facilities for heavy streams of continuous overland transportation.

To do imperatively needed work Commissioner Miller is advocating a state highway overall expenditure of at least $30,000,000 annually for the next five years.

"Such capital investment," he explains, "can be economically justified to provide much needed relief."

Partial Appropriations Available

For the fiscal period ending July 1, 1947, the Legislature has made $33,567,828 available for a state highway construction program financed through state funds and by the grants of the U. S. Public Roads Administration.

The Federal allocation is the largest in the history of New Jersey and was obtained through the efforts of Commissioner Miller in cooperation with the officials of the more popular states. They attended the hearings in Congress and were successful in their convincing arguments that more aid should go to states where highway congestion is the greatest and the need for Federal aid the most urgent.

As compared with prewar years when New Jersey's Federal aid amounted to less than $2,000,000 annually the new Federal appropriation gives the state $9,433,928 yearly for a three-year period. This sum will be divided three ways annually. For the improvement of the State Highway System, $2,864,310; for farm-to-

market or secondary rural roads, $1,041,631; and for roads in urban communities, $5,527,987.

Farm-to-Market Roads

New Jersey has 19,000 miles of rural roads and sections approved for the Federal-aid Secondary System which are being placed in construction programs. The Federal Government grant of $1,025,774 for three successive years to be matched by the Boards of Chosen Freeholders will permit modernization of important county roads to provide wider lanes and flatten the crown to eliminate accident hazards. This contribution on farm-to-market highways is in addition to the $9,885,000 appropriations made directly by the state each year to counties, towns, townships and boroughs.

Through the Federal aid balances of previous years 23 miles of construction have been authorized. The Boards of Freeholders have submitted programs for an additional 103 miles to be built during this year and early next year. The Federal funds available, however, may require that the work on these county thoroughfares for connections to feeder links in the rural areas may have to be limited to approximately 50 miles or a total of 73 miles during the remainder of this year and the early part of next.

Impressive Program Total

Available appropriations give indication that substantial strides in road construction are in prospect for New Jersey this year.

To the state highway appropriations of $33,567,828, will be added $2,051,488 of matched Federal and county funds for the federal-aid secondary system and the $9,885,000 in direct appropriations of New Jersey state money for roads and bridges in counties, town, townships and boroughs. Total for 1946 is $45,504,316.

A word about New Jersey's STATE HIGHWAY ENGINEER

Charles M. Noble, until recently a Commander in the Seabees, is the man, who as a New Jersey's state highway engineer, is directly responsible for the execution of that state's $45,000,000 1946 highway program.

Thirty years of engineering in Florida, Alabama, North Carolina, Kentucky, New Jersey—and more recently on advanced bases in the Pacific Ocean—largely on highway construction, provide the background of experience which he brings with him to his present position. Included also are projects involving harbor development, bridges, hard rock and subaqueous tunnels and naval bases. Thirteen of these years were spent as an engineer with the Port of New York Authority on projects totalling $150,000,000. During the construction of the $70,000,000 Pennsylvania Turnpike Commander Noble served as special highway engineer.

Fine War Record

World War I found Noble on subchaser service in the English channel. World War II saw him as commander of both the 22nd and 6th U. S. Naval Construction Battalions giving the Japs trouble.

In Alaska and the Aleutians it was naval bases, airfield, docks and the general run of naval construction.

In China it was engineering reconnaissance behind the Japanese lines preparing for landings on the China coast.

Admiral Nimitz placed him on his staff at Pearl Harbor and then in Washington he was deputy director of Advance Base Department of the Bureau of Yards and Docks.

His work in World War II earned for him the legion of Merit Medal and the Bronze Star Medal.

In the field of engineering writing Commander Noble has demonstrated unusual ability by winning the American Society of Civil Engineers Arthur Wellington prize for a paper entitled "The Modern Express Highway" and the Boston Society of Civil Engineers' Clemens Herschel prize for a paper on "The Factor of Safety in Highway Design." He, together with two associates, received honorable mention in an International competition for an elevated highway design.

The Commander is a member of the American Society of Civil Engineers, New Jersey and National Society of Professional Engineers, Highway Research Board, and the American Road Builders' Association. He holds professional engineers' licenses in New Jersey, New York and Pennsylvania. The benefit of Commander Noble's highway and engineering experience is made available both through his writings and through the work he does as a visiting lecturer for Yale University's Bureau of Highway Traffic.

N. J. a Leader in Traffic Safety

The accompaning article on New Jersey's bold free and parkway program would be incomplete without reference to the thinking that New Jersey highway leaders have done on the problem of eliminating highway accidents. At the American Road Builders' Association meeting last winter, Commissioner Spencer Miller, Jr. presented a notable paper, entitled "Traffic Deaths—Challenge to the Highway Industry." Excerpts from this paper are reproduced in the following

THAT the traffic accident problem is concentrated on the more heavily traveled highway routes is borne out by a study made in New Jersey in 1934 where it was demonstrated that on the state system of 1500 miles, which is about 10% of the 15,000 miles of improved roads in the state, 21% of all accidents occurred on the state system; and the rate of fatal accidents which occurred on state highways was nearly double the rate on other than state highways. This does not by any means imply

that the design of these state highways is inferior to other highways in the state, but it does indicate that highways subjected to heavy volumes of fast-moving traffic require special design policies and treatment, and this demonstrates the necessity of instituting without further delay a bold, though sound, modernization program. During the war this was not possible. These modern facilities should have the following features:

1. Separation of streams of traffic flowing in opposite directions by a median strip and the provision of at least two wide lanes in each direction in order to reduce the possibility of head-on collisions and sideswipe accidents.

2. Elimination of all highway and railway grade crossings so that there will be no traffic lights and cross traffic.

3. Utilization of the "Freeway and Parkway" principle of controlled access, thus preventing commercial ribbon development along the highway and early loss in transportation efficiency and eventual obsolescence.

4. In open areas the provision of wide, smooth, stable shoulders level with the pavement to enable vehicles to park completely off the paved area and to provide "elbow room" in cases of traffic emergency or mechanical failure.

These modern types of highways should contain the following features:

a. Exclusion of pedestrians.

b. Adequate design standards to care for present speeds and to allow for possible increased speeds in the future.

c. Provision of specially designed access and exit facilities at appropriate intervals to permit safe entry and exit to avoid traffic turbulence.

d. Abolition of parking on the pavements.

e. Roadside planting. The effort to improve the appearance of the roadside by landscaping will not be regarded as a dispensary extra in the motorways of the future but an essential part of it. Nothing which adds to the appearance of a road detracts from its efficiency.

Figures accumulated in New Jersey indicate that 21% of all highway accidents in this state are right angle, 30% same direction, 21% opposite direction (head-on), 11% fixed object, 10% pedestrian, and 7% miscellaneous. A brief analysis of the effect of the above listed design objectives on highway accidents may be made as follows:

Effects of Highway Design on Accident Frequency

If all highway and railway grade crossings are eliminated it will be physically impossible for a right-angle type of accident to occur due to cross traffic and thus 21% of all accidents should be eliminated. Many types of "same-direction" accidents are caused by the influence of oncoming "opposite-direction" traffic, and if the divided highway principle is utilized, this type of causation should be eliminated. Wide, smooth, stabilized shoulders, level with the pavement, permit lateral freedom and will have a favorable influence on same-direction accidents. Many "same-direction" accidents are caused at intersections by the stopping of vehicles at traffic lights or slowing down or stopping to make a turn or to orient the driver. If grade separation and divided highway design with proper direction signs and with wide shoulders are utilized it is certain that "same-direction" accidents will be materially reduced, perhaps to the extent of 20% of all accidents. The "opposite-direction" accident can be largely eliminated by the provision of a wide space separating "opposite-direction" traffic possibly to the extent of accounting for the total of 21%. If all fixed objects are removed for a reasonable distance from the pavement the fixed-object accident can be largely prevented, but in order to be conservative it may be assumed that surely one-half of these accidents can be eliminated, namely, 6%. In the case of pedestrians, if their presence is removed from the motor areas and provision is made for them elsewhere, this type of accident can be almost entirely prevented and it is reasonably safe to state that all but 2% of the total can be eliminated, namely, 8%.

A recent study of the "Before and After" accident experience on the state highways of New Jersey which have been dualized, reveals very conclusively the effect of this practice of "Highway Modernization" upon the accident fatality rate. The study covers 10 years from 1935 to 1944, showing before and after accident experience for the dualization of all 3 lane and 4 lane undivided roads which were improved in 1938, 1939 and 1940 and for which the accident records are available. These roads are all heavily traveled with 1941 average day volumes varying from 13,000 to 41,000 cars per day. They include 6.25 miles at Route 4 from River Edge to Fort Lee, 16.79 miles at Route 25 (US 1) from New Brunswick to Linden, 4.92 miles at Route 26 (US 1) in Lawrence Township, and 19.67 miles at Route 29 (US 22) from Bound Brook to Hillside. The total mileage is 47.63 miles.

This study demonstrates conclusively that the fatality rate can be reduced by improved highway design as well as by proper education and enforcement. This reduction is devisable as follows:

Education and Enforcement	25%
Dualization	31%
Grade Separations	28%
Remaining	16%
	100%

Assuming that the 25% reduction due to education and enforcement is permanent and constant, any future project of dualization and grade separations should result in a reduction of 79%. Dualization would be responsible for 42% and grade separations 37%. The remaining 21% would remain and could only be reduced by an increase in education and enforcement. A similar story can no doubt be presented by every other state in the Union.

The lesson is clear that an accelerated highway program utilizing modern highway design techniques will have a pronouncedly favorable effect on traffic fatalities in this country.

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Brazil Building Road Thru Vast Unopened Area

Brazilian army engineers have launched an ambitious project to connect the east coast of Brazil with its Bolivian frontier by a road that will open thousands of square miles of new area for settlers, mining engineers and lumbermen. For years, Brazilian military men have felt that the frontiers of their rich but sprawling republic were too inaccessible for adequate protection. Mining engineers have long believed that the high plateau lying between the Amazon and Paraguay rivers contained minerals worth exploiting. The new road will cut directly across the center of this plateau.

Rivers are too large and too frequent to be bridged, and will be crossed on steel-barge ferries. Each crossing will have a barge strung on a cable, and the barge will be cranked back and forth across the river manually. Barges will be fabricated on the site by welding steel plates together. Some of these barges are already in operation, and have proved satisfactory.

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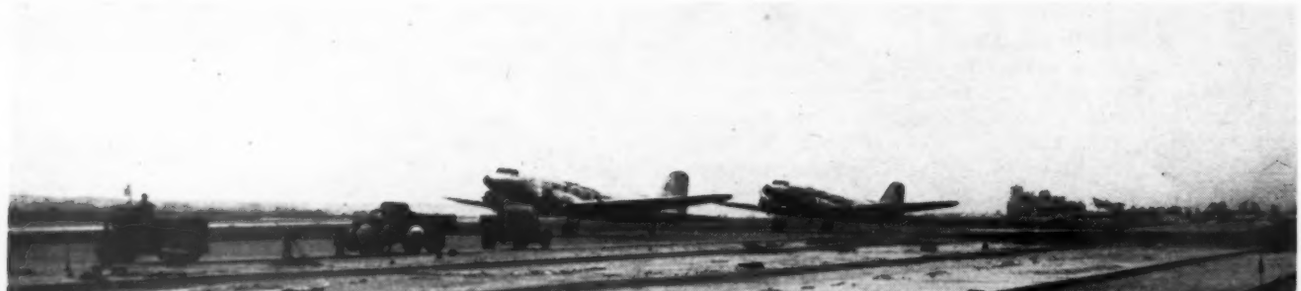
State highway departments let 425 contracts in May for Federal-aid projects that will cost $58,166,360, as compared with a total of 392 contracts awarded in April for work costing $55,932,506, according to reports received by the Public Roads Administration from its field offices.



★ Two planes are shown lined up on taxiway. If lead plane encounters delay the second plane cannot pass. Note that alternate lanes of concrete pavement are being poured to reduce delays which would otherwise be caused by curing time. Paper curing is being used

Novel Taxiway Improvements at Washington National Airport Allow

Speeding Up of Ground Traffic

Paving Project on widely different types of subgrade material presents design and construction difficulties which are being overcome by bearing tests, pipe drains and the use of proper construction equipment

NOT very long ago critics used the expression "over-building" when referring to the size and layout of the Washington National Airport. Inadequate facilities and bottlenecks are the type of words which apply today. Eighteen thousand flights in one month are becoming common-place. Every airport building is overcrowded and new buildings and additions to old buildings are under way.

Mr. Hervey F. Law, Airport administrator, and the Washington, D. C. Engineer Office have worked out novel taxiway improvements designed to speed up ground traffic. As near as can be determined this is the first instance where by-pass parking aprons have been installed to relieve the congestion which invariably occurs where taxiways and runways join. The Wilmoth Paving Company of Washington is doing the work. Thirty thousand sq. yds. of pavement together with the necessary excavation and drainage is estimated to cost $250,000.

Planes Pile Up

In explaining the problem involved it must be pointed out that it is standard practice everywhere for departing airplanes to taxi out to the take-off end of the runway in use and there warm up and test their motors. At busy airports it often happens that from two to as many as five or more planes taxi out at the same time, one behind the other. Taxiways 50 to 75 ft. in width will not permit one plane to pass another so they must take off in the order in which they

★ Pans, track tractors and bulldozers defy even the worst conditions which a very mucky hydraulic fill material can present

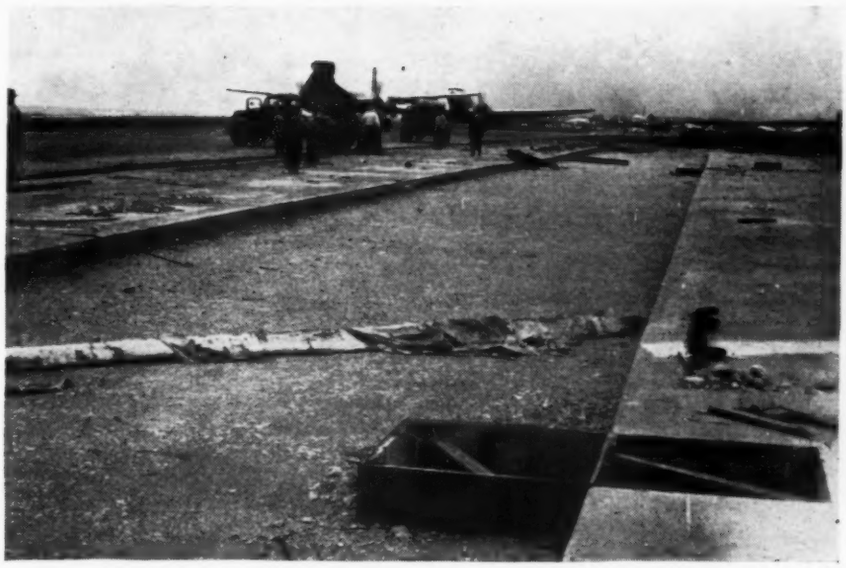
★ Unsuitable materials are being excavated to ground water level

are lined up. Traffic is controlled at most airports with such things as flight plan approval or company clearance required before the tower can clear a plane to take off even after the pilot has reported it ready to go. It frequently happens that the lead plane experiences considerable delay in securing clearance. This, of course, results in all of the planes on the taxiway being held up too. Tight operating schedules have long indicated the need for some arrangement whereby an airplane which has clearance can proceed past others which are being held up.

By-pass parking aprons are simply a widening of the taxiway as is shown in Fig. 2. Figure 1 shows the arrangement of by-pass aprons being installed at Washington National Airport. Planes will warm up on the apron instead of the taxiway and it can be seen how passing is easily possible. The aprons are being constructed of 10 in. thick concrete pavement.

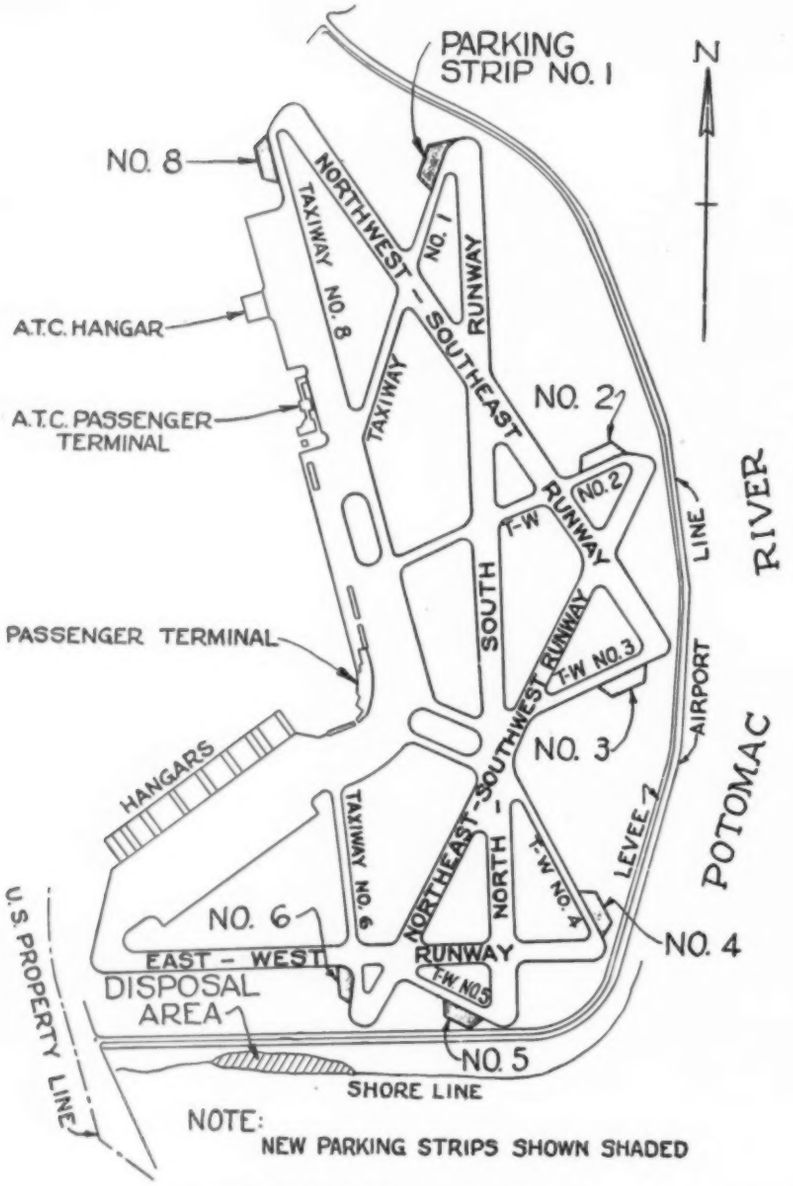
Subgrade Varies Greatly

The design of the hydraulic fill which forms most of the airport is causing engineering and construction



★ Close-up view of compacted bank-run-gravel subbase. Note openings left for drainage structure to remove surface water. In background a truck is dumping hot-mix surface course material to provide joint between concrete and asphalt pavements. Four planes can be seen on taxiway, further illustrating possible congestion

★ (Left): The weight of this rig is such as to provide exactly 5 lbs. per sq. in. pressure on the bearing plate shown. Note push button connecting with vibrator attached to Ames gauge support. Operating buzzer vibrates dial sufficiently to insure against inaccurate reading due to hand sticking. (Right): Interior view of equipment and tool truck which accompanies bearing test rigs. One hand on gauge provides normal weight readings while the other, painted red, is set to compensate for weight of bucket. Red hand reading eliminates need for subtracting weight of bucket



LOCATION MAP

★ Fig. 1

difficulties. All original paved areas in the fill have selected granular material underlying them and extending outward as much as 10 to 20 ft. on either side. The fill outside of the paved areas is a mixture of silt and clay dredged from the river bottom with some sand and gravel interspersed. Since the underlying muck fill is saturated and consequently has poor stability, care is necessary where pavements are to be placed on such material. The original airport layout did not contemplate by-pass aprons so most of the new construction requires sub-grade treatment.

Pipe Subdrains Help

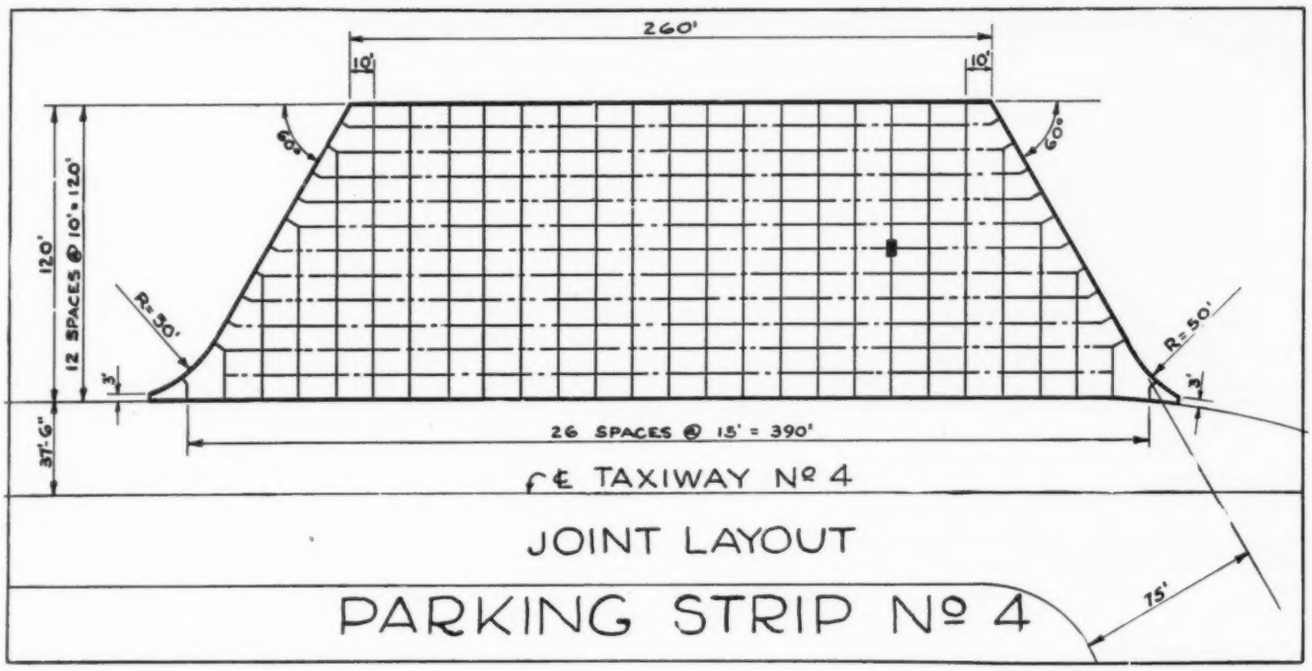
Grade-invert-pipe sub-drains are being installed to lower the water table where wet sub-surface conditions exist. Figures 3 and 4 show the method of installation of the pipe. Similar installations of this nature have proved very satisfactory on this airport.

Pavement Thickness Can Vary

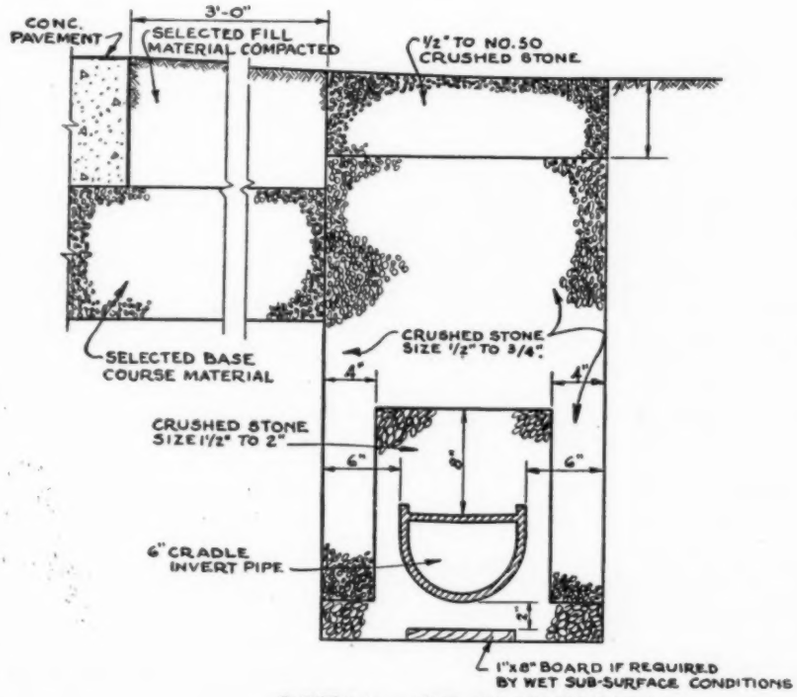
The construction specifications have been prepared in anticipation of encountering non-uniform sub-grade conditions. Sub-base thickness as well as pavement thickness is stated as being dependent on the results of essential field bearing and laboratory compaction tests.

Since the surface elevation of the existing ground is very irregular, time is saved by not taking the borings until the contractor has excavated the 20-in. depth required for base course and pavement. Borings reveal the water table elevation and the nature of the underlying soil. Immediately upon completion of visual observation

★ (Left): Joint where concrete pavement adjoins asphalt pavement is made by cutting asphalt pavement back from one to four ft. and then replacing with hot-plant mix. (Right): Hot-plant-mix joint is thoroughly rolled to provide smooth riding and firm pavement



★ Fig. 2



DETAIL OF SUBDRAIN ADJACENT TO PAVEMENT

★ Fig. 3

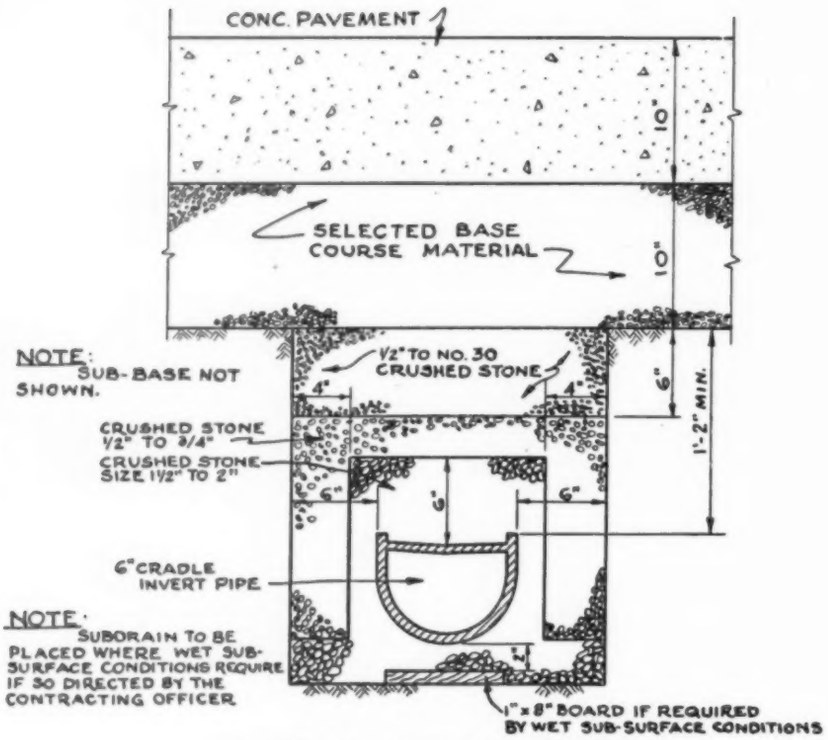
Bearing Tests Used

Upon completion of the sub-base which consists of carefully compacted bank-run gravel, plate bearing tests are conducted to determine both the extent of the contractor's compliance with the compaction specifications and the corresponding required slab thickness. The latter depends both on the sub-grade modulus determined by the bearing test and the flexural strength of the concrete as determined by continuous tests. Where unstable sub-grade conditions make it impossible to obtain a high enough sub-grade modulus or where the concrete proves to have lower than the design flexural strength, the slab is thickened to provide the required capacity.

Test borings nearly always indicate where such areas may be expected.

and laboratory tests, the depth of sub-base is decided upon and the contractor is allowed to proceed with the sub-base excavation. The sub-base is about 3 to 4 ft. thick in the deepest sections and is constructed of very coarse material of which not more than 20% can pass the No 10 sieve. With such material good stability is obtained with a very minimum of compacting effort.

★ (Below): Weighted with concrete blocks this easy-to-get-in-place rig provides a plate bearing reaction of 30 lbs. per sq. in. on a 30 in. diameter plate



DETAIL OF SUBDRAIN UNDER PAVEMENT

★ Fig. 4

The accompanying photographs show the two types of plate-bearing-test equipment being used. The heavier rig allows pressures on a 30-in. diameter plate varying from 2.5 to 30 or more lbs. per sq. in. The small rig is designed for a 5 lb. per sq. in. loading only on a 30 in. diameter plate. The latter rig was designed by the Washington Engineer Office for use with an abbreviated procedure that can normally be completed in less than 30 minutes. The large rig which complies with the standard procedure requires 2 to 3 hrs. for each test and is used principally as a check or control against the quick test.

Design of pavements and testing is a function of the Branch of Civil Engineering of The Washington U. S. Engineer Office. Col. D. G. White, Corps of Engineers, is the District Engineer, Edmund F. Preece is Chief of Civil Engineering, and Hermon L. Cooper is Chief of the Foundation and Construction Testing Section. The work is being constructed for the Civil Aeronautics Authority.

New Weed Killer

A powerful new weapon developed during the war is being thrown into action this year against the weed kingdom. It's a chemical spray with the formidable name of 2, 4-dichlorophenoxyacetic acid, according to a bulletin from the Dow Chemical Company. Maintenance men, driving trucks containing spray rigs with boom attached, spread the misty spray on roadside shoulders.

One of the most efficient booms for applying the spray is the general purpose type built in three sections, with the two end sections hinged to the center portion for flexibility of movement with the contour of the ground. For roadside spraying, the left end section is removed and the right end section applies the spray along the shoulder. This type of boom, or similar equipment which can easily be made with available materials in maintenance shops, also is being used for spraying golf courses and other extensive grassy areas.

The killing substance is one of the most potent of a group of chemicals that influence plant growth and behavior. Mixed with water in proper proportions, it kills in dramatic fashion, states this bulletin. It enters the leaf and travels to other parts of the plant, throwing the growing mechanism of the weed entirely out of kilter. Leaves and stems twist and curl, roots start to decay and then the plant dries up and dies.

Fortunately, bluegrass and most other members of the grass family are not injured by 2, 4-D spray.

Some 100-odd common weeds, including narrow and broad leaved plantains, dandelion, bull thistle, burdock, nettle, wild carrot, hedge bindweed, cinquefoil and honeysuckle are usually killed with one application. Other hard-to-kill weeds with extensive underground root systems may need two or more applications before they succumb. Among these are Canada thistle, field bindweed, goldenrod, milkweed and poison ivy. Spray should be applied when plants are in an active growing condition. Spray mixtures of 2, 4-D, as recommended with a number of formulations now on the market, are non-poisonous to human beings and domestic animals, as demonstrated in experiments.

Extreme care should be used to confine the spray to areas to be treated, as 2, 4-D is fatal to a wide variety of vegetables, flowers, shrubbery and trees. The best practice is to avoid spraying when a breeze is stirring as mist from the spray may be blown on desirable vegetation with disastrous results. Furthermore, it is highly important to remember that spray equipment should be cleaned thoroughly as directed before re-using it for other spray purposes.

•

The extent of rural highway use by farmers is shown by an estimate compiled in New York state. During 1944 farm trucks rolled up a total probable mileage of over 400 million, despite gas rationing.

★ As described in the accompanying article, this clay-gravel road was constructed in 1940, by scarifying the subgrade to bring up binder, and adding about 1,000 cu. yd. of gravel per mile. Little maintenance since, and a very good road today but with more loose material than had some crushed stone also been used. Again, note wide ditches and high grade

Stabilized Gravel Methods

in Cerro Gordo County, Iowa

Clay and, more recently, crushed stone, have been added by this practical county engineer to build up a nearly 100% surfaced county road system on a limited budget

By R. E. Robertson

County Engineer, Cerro Gordo County, Mason City, Iowa

SINCE before the first world war the agricultural county of Cerro Gordo, Iowa, has had the problem of getting and keeping farmers out of the mud with limited expenditures per mile per year. While this county was the scene of the first mile of concrete pavement in Iowa—placed in 1913 on U. S. 18 north of Mason City—the road surfacing done on the county system has been almost entirely a matter of graveling and stabilizing with binder materials. Year by year we have added to our graveled mileage until this year we have literally given every farmer in the county a gravel road past his door but one, and we'll get him before the season is over. Over 889 miles of the 1020 mile county system is now graveled.

Glacial gravel is a plentiful product in this region. Our procedure has been simple. Today we are adding some crushed limestone, but previously the steps in building us a road consisted of the following: first grade the roadway to a roadbed elevation well above the ground (to minimize snow drifting), throw down a gravel carpet, let traffic work it in, and later add clay or disc fine soil up from the subgrade to help bind the road into a tight stabilized structure. Crusher-run crushed gravel has always been specified, in order to get the maximum of fines. We have observed that so-called well graded crushed material doesn't have the excess of fine material needed to offset kicking up by traffic and loss by wind during the period of traffic consolidation.

One example of clay-bound gravel that has stood up very well is shown in the accompanying photograph, taken this year. Built in 1940, this road was one of the first to utilize the practice of scarifying. Instead of waiting for traffic to work binder soil up from the subgrade, we scarified the old roadway rather deeply, going well below the gravel mat. New gravel was then added, and the whole mass turned over three or four times and spread out a little at a time. About three weeks was necessary to get all the windrowed material into place and well solidified by traffic. This operation required about a thousand cubic yards of gravel per mile.

Subsequent maintenance of this section over the six years has required use of a little gravel in weak spots, about 85 cu. yd. per mile during the period. The surface today is relatively free from loose particles kicked out from traffic, and should be good for several years more of service under typical farm traffic averag-

Then and Now—32 Years Apart

★ These two remarkable "pair" pictures show U.S. 18 north of Mason City, just after completion of the bridge shown. The pavement was placed in 1915, and after 31 years is slated for reconstruction. The concrete pavement, according to County Engineer R. E. Robertson at Mason City, was a two-course job such as was common at that time. Steel armored transverse joints are today in excellent condition. The road was built by piling aggregate on the subgrade and transferring to the paver in wheelbarrows. Wood forms—sloppy mix—hand strike off—remember? Or are you too young? Mr. Robertson attributes the durability of this pavement partly to the excellent quartzite aggregate used

ing perhaps a hundred or more vehicles daily. As to routine maintenance, the patrolman goes out about twice a month and pulls loose material over to the shoulders, dropping this material in holes, etc.

Speaking of traffic, in our opinion, there is no such thing these days as a "light traffic" road, since farmers have some very heavy trucks and no one knows when heavy vehicles from the arterial traffic will occasionally pass. *Infrequent* traffic roads is a better term.

Now Adds Stone

While excellent results were obtained utilizing experience from year to year with local gravel, we have now swung over 100% to build up our gravel roads with the addition of both crushed stone and binder clay. The stone increases the initial cost, but the results are decidedly superior, as shown by a trip over our county system to compare older and newer sections.

At first crusher-run limestone of 1-in. max. size was specified. Now ¾-in. is used. About 1,000 to 1,200 cu. yd. of new material per mile is usually placed in a surfacing operation, depending on the condition of the road and the amount of gravelly material already present. Stone, gravel and clay are mixed with a blade in proportions based on judgment and windrowed alongside the roadway. Prevailing practice is to combine about 500 yd. of gravel and about 500 yd. of rock per mile, adding 15% clay.

Water content of the mix is watched with care. When a visual inspection shows that the moisture content is about right for good spreading and traffic compaction, the operator comes along and blades in a little at a time as fast as traffic can take care of it.

That's about the whole story except that it is important for the patrolmen to be on their toes and get out promptly after rains. Light blading at such times keeps chatter bumps down, keeps loose material under control, and helps maintain a dense, well stabilized surface.

Costs About $100 per Mile

Maintenance until the past two years has averaged about $100 per mile per year, the entire county sys-

★ Example of stabilized road surface consisting of 50-50 gravel and crushed stone plus 15% clay. Note the deep, wide ditches and raised elevation of the roadway, designed to minimize snow removal

tem of 1020 miles being taken care of with an annual budget of around $100,000. Our costs are up probably 25% this year, which is a very satisfactory percentage considering the times. We contracted for 60,000 cu. yd. of material last year and will use about the same yardage this year, making this yardage do in an effort to catch up with skimped wartime maintenance.

The County has its own gravel pits, and crushing and stockpiling are commonly performed under contract. For example, one firm put up 10,000 cu. yd. last winter. The County pays the farmer for gravel on a "where is, as is" basis at the rate of about five cents a cubic yard and strips and levels, the contractor taking over from there. Crushing and stockpiling last year cost around 35 cents a cubic yard, but may cost more now under inflated conditions. Hauling was paid for in 1945 at 10 cents per yard-mile, the price increasing in half-mile increments. Gravel hauling averaged about six miles and a road graveling job usually cost about $1,000 per mile.

Crushed stone has had to be hauled somewhat farther, about an 8-mile haul. Stone is costing around $1.35 per cu. yd. in the stockpile.

Each year we regrade several miles of road, to raise the grade a foot or two and widen. Over 400 miles are graded up and by the time we get 650 miles of road thus listed, our snow plowing costs should be further reduced. Plowing costs already show the economy of raised grades and the more such roads we get, the more we'll benefit from the winds that we used to curse for causing drifts.

Our county equipment, used for winter maintenance of course as well as summer, includes twelve heavy graders, all diesel except two, plus five 5-ton trucks and two smaller trucks.

The big thing since the war in highway work is to have plans ready. Cerro Gordo County was fortunate in having 125 miles of road improvement plans ready this year and 23 miles more in the survey stage. Over 23 miles of improvements were under contract by the end of April.

•

2,410 Traffic Deaths in May

Traffic deaths of 2,410 for May bring, according to the Automotive Safety Foundation, the 5-month toll to 13,180. That total is a 43% increase over those killed in the same period of 1945, but is 6.6% less than the toll claimed in the five months of 1941, the worst year of all. May fatalities were 36% over May of last year, and 21% under those of May, 1941. This is by far the greatest drop shown for any month of 1946 over 1941.

★ The gentle slope on the right of this road used to be a high, steep bank which caused a snow battle every winter. Little plowing is needed since this daylighting job, which involved about 5,000 cu. yd. Top soil is replaced to a depth of three inches and the farmer usually is well pleased

Three significant events were launched in May which may have been factors in the fatality drop: the President's Highway Safety Conference; the Police Traffic Safety Check, sponsored by the International Association of Chiefs of Police, and the Take It Easy campaign, sponsored by the American Automobile Association.

Travel on rural roads in May, reported by the U. S. Public Roads Administration, maintained its high volume, 54% over May, 1945, but was 6.8% under 1941 when nearly 5,000,000 more motor vehicles were being operated.

•

Town Meeting on Rural Road Problem Held in W. Virginia

West Virginia's rural residents, taking a leaf from the Old New England Town Hall meetings as suggested by Road Commissioner Worthington, are rapidly organizing their respective magisterial districts to further efforts to secure stabilization of the 16,000 remaining miles in the West Virginia unimproved system. All the rural roads in this state are under the state road commission.

Worthington's plan to leave selection of the roads to be improved up to the farm dwellers who are using them day in and day out appears to be meeting with success. So far 170 magisterial district meetings have been held in 41 of the state's 55 counties. Briefly, Commissioner Worthington's plan calls for open meetings in each of the state's 352 magisterial districts. At the initial meeting six representative citizens will name a magisterial chairman and select one or two projects in their respective districts for presentation at a county-wide meeting. From this latter meeting will emerge projects tabled for improvement with the mileage involved dependent entirely upon the amount of money available for the year's work.

Once selection has been made future and final action will be in the hands of the Commission's district office and the Public Roads Administration. Provided the projects fit into an integrated highway system and contain sufficient merit, they will be programmed for prompt improvement.

The plan calls for funds for the various counties to be allocated on an equitable basis, taking into consideration total and rural population, total and secondary road mileage, and mileage of unimproved roads.

Commissioner Worthington arrived at his plan after careful and detailed study revealed more than 16,000 miles of unimproved roads in the secondary system. To attempt to complete this improvement through the cheapest form of stabilization—estimated at $10,000 per mile—would take forty years if state and federal allocations are continued on the prevailing basis.

If this out-moded method were continued over a 40-year period, half of the roads improved under this procedure would be worn out long before the improvement expiration date arrived and the added maintenance costs of these roads would be prohibitive, Worthington contends. The Commissioner explained that a more practical plan would be to set up a five-year program, centering on some 1,500 miles of the improved system each year, thereby completing approximately 7,500 miles during this period.

While 16,000 miles are listed on the unimproved system, Commissioner Worthington believes that half of this mileage could be eliminated, for he points out they are roads upon which the traffic volume will never justify any extensive improvement.

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Western Highway Officials

discuss low salaries, rising costs, many legislative and engineering phases

ADMINISTRATIVE and legislative questions and the broader aspects of highway engineering were discussed in a lively three-day session of the Western Association of State Highway Officials. The meeting, held June 10-12 at Salt Lake City, was marked by a deep concern over technical man-power. The current shortages of materials, specially acute for bridges, was seen to be a transitory trouble, but not so the inability of some of the states, including notably the host state of Utah, to attract able engineers due to low salary scales and an unhappy political situation. In the meeting and in the corridors this subject came in for plenty of discussion as one affecting the long range advancement of highways.

L. S. Tuttle, assistant to Thomas H. MacDonald, public road commissioner, told the 142 delegates that an immediate overhaul of state highway departments was needed, with a goal of obtaining higher salaries to attract additional experienced personnel. He named low salaries, lack of civil service and lack of retirement benefits as the three main reasons why highway departments were unable to obtain complete and competent staffs. Public support and understanding must be enlisted if the condition is to be improved in a large number of states throughout the nation.

While construction costs have risen some 50%, no instance of a 50% raise in salaries is to be found among state highway departments.

Higher Construction Costs

A panel discussion on administrative problems and legislation was held under the leadership of L. I. Hewes, deputy commissioner of PRA.

A rise of 66% in highway project cost per mile was reported for the first quarter of 1946 compared with the same quarter in 1940. This rise, well above that foreseen at the close of the war, was attributed partly to the accumulated need of repairs but more to out-of-line costs of structural and reinforcing steel. In this connection note was taken of approval recently given the Michigan state highway department to contract directly with suppliers and fabricators for steel to expedite work.

A. F. Winkler, Montana, was elected President of the Western Association at the Salt Lake City meeting; Mat Hally of Idaho, vice president; E. V. Miller of Arizona, secretary.

The growing cost of reinforced concrete was also a subject of concern. Costs in the Los Angeles area, for example, which were formerly at the low figure of $14 to $16 per cubic yard, have soared to $35 or $40 due largely to labor. A spokesman for the California division of highways said he could not see how the state's large urban programs can proceed in 1947 if project approval is to be governed by any arbitrary percentage ruling in relation to 1940. Public necessity is the big question, and in the case of the Los Angeles area and elsewhere in the west the continued influx of new population and business expansion make it acutely necessary to get freeway programs moving faster.

J. S. Bright, deputy commissioner of public roads, Washington, D. C., summarized national progress in federal-aid lettings (including figures essentially the same as those given elsewhere in this issue from an ARBA bulletin). He also reviewed recent OPA attempts to enter the construction picture. OPA has been concerned mainly with a possible increase in the percentage of profit in contract work, and was assured that state highway departments would do everything possible to see that such profits stayed in line, in the event competition wouldn't take care of that question automatically.

Surplus War Equipment Question Again

Highway departments clearly have run a poor fourth in the competition to get their hands on the little construction machinery released by the government. Federal agencies, veterans, and the War Assets Corporation representing small business have come first. A spokesman of the Wyoming state highway department outlined a sad instance of the red tape and delay involved in tracking down equipment offered for sale.

Grade Separations

Grade separations and their financing were included in a round table session. The problem isn't one of funds usually, observed D. C. Greer, Texas state highway engineer, but of getting the railroad to agree to any percentage of damage other than zero. New structures direly needed for highway traffic admittedly may be of little value to the railroad, but in cases where there are seemingly clear safety and other benefits, there has been difficulty in getting the railroads to agree on a reasonable percentage share of the construction cost.

In California, it is understood that right-of-way condemnation laws have sometimes enabled the highway department to set damages and proceed with little delay.

Better Right-of-Way Laws Needed

States in the west which haven't as yet obtained passage of modern, fully adequate right-of-way laws should do so as soon as possible, pointed out Fred Grumm of California. He urged at the same time that such laws be kept simple. He referred to California's present excellent laws, which are a factor in this state's ability to step out with a remarkable freeway program leading the nation. California has established over 600 miles of freeway since 1939. Maintaining the integrity of the roadside is a paramount long range question, and there is no phase more important to the long-time benefits and value of the highway.

Mr. Grumm warned that rural highways which today are relatively free of ribbon development will not always

remain free of such encroachment, and laws passed to limit roadside development now may save huge damages later.

An able paper on right-of-way legal aspects was read by J. M. Devers, chief counsel, Oregon state highway commission. This paper, which stressed the basic right of abutting property owners in the commercial benefits of their location, will be presented in full in a later issue of ROADS AND STREETS.

Stretching Road Funds

How a state's highway finances are strained by the constant addition of mileage to the state system, was pointed out by C. B. Shain of Washington. Each session that state's legislature has added new projects—2200 miles in recent years—until today including wartime accumulation 150 million dollars in state projects are waiting their turn with another 80 million not even docketed.

The highway has grown so greatly in public importance that today no state can afford to allow them to be political benches, observed Mr. Shain. Proposed cost of each project, usefulness, traffic carried, estimate of cost and place on a priority list are to be tabulated for legislative approval. Under present efforts to apply an engineering approach to highway project selection, the state's resources are to be evaluated and every mile of highway improvement based on an analysis.

Legislators haven't had time or opportunity to evaluate the situation brought about. It was stressed that organized facts on highway funds and betterments should be compiled and presented to legislatures as one of the chief responsibilities of every state highway department.

The continued great disparity between revenue means in the various western states was noted. Vehicle taxes now range from $1.58 to $33.70 in individual states. Total average highway user revenue per year per vehicle runs from $29.02 in California to $51.63 in New Mexico. Ratio of state aid to total road funds ranges from none to 44% in the case of Washington.

Adding to this chaotic picture, roads charges to truckers especially vary greatly, showing a complete lack of scientific yardstick. The highways must be designed to pay their way, and the various users to pay their just share to make roads a business institution, and each state must solve its own problem as part of a regional as well as a state pattern. Next year is a legislative year in most states, and it was seen that concerted action should be undertaken at once.

A panel discussion of engineering problems under Fred Grumm of California took up geometric design, bridge design and maintenance, highway safety and aerial surveys. On the subject of geometric design, a general acceptance in the west was reported on standards proposed by PRA and AASHO for interstate highways. Arizona has frequently surpassed the minimum requirements, for example, trying for 30′ rather than 2° 30′ curves when not costly. The important point was brought out that minimum highway standards can very often be greatly exceeded, to the added safety and traffic value of the road, at little or no additional cost. Width decisions are particularly important, and while less than minimum standards must sometimes be requested due to heavy terrain or right-of-way restrictions, wider-than-standard widths are also often desirable. Again citing Arizona, the 44 ft. width for interstate highway projects hasn't been used, but rather 40 ft. widths providing 12-ft. traffic lanes and 8-ft. shoulders. This slightly reduced width has been necessary to keep down grading, surfacing and bridge costs.

Shoulder as a Lane

Discussion touched on the traffic-lane effect of sealing shoulders along 2-lane roads. The result is what appears to be a 4-lane bituminous road at times, and vehicles using the road as such must be given conspicuous warning at approaches to two-lane bridges. Bridges should be built full shoulder width. In California, shoulders are almost universally treated. Width adopted on interstate routes is 10 ft. and the courts have said that such shoulders are traffic lanes and that citizens have rights to use them as such. California highway department personnel, however, still prefer the 8 ft. shoulder for arterial use. This width is necessary to provide for emergency stoppage.

A plea for flexibility in determining cut and fill slopes was voiced. California men are not all sympathetic with the iron-bound use of 4-to-1 slopes, as specified for interstate construction. Such an adherence might add millions to road costs. On a 10-ft. fill this slope means an 80-ft. spread. Such a slope, however, may be justified at times on urban projects, as an element in beautification.

Cost Limitations

Some inter-state sections, including some in Utah, carry less than 1,000 vehicles a day, and their cost must definitely be limited. Allan of Nevada rounded out the design discussion with a forceful plea for "young" ideas. Again showing the need for flexibility of approach, some primary roads in Nevada carry under 500 vehicles daily, and will have less than 8 ft. shoulders, yet are easily built to alignment and sight distance ample for 70 mph. travel. The full shoulder width is usually paved for safety and to reduce maintenance. He advocated 4-lane construction over occasional mountain-tops or along infrequent spots where sight distance is reduced. Again, in Montana, the funds available are low compared with the mileage of interstate routes to be improved, and permission has been asked to improve the surface for smoothness and load carrying capacity as a primary immediate means of giving needed highway service.

When and when not to provide separation was a lively topic. A California spokesman said his state's practice is to consider an intersection worthy of a separation structure only when it accommodates over 3,000 vehicles a day. But even when present traffic is considerably less, it is important to obtain right-of-way for ultimate construction of an underpass.

Also mentioned was the problem of providing safe transition from 4 to 2 lane roadway width. California data indicate that it takes a driver only 5 seconds to go from 4 to 3 lanes, and 8 seconds from 4 to 2 lanes. More facts are needed on this important safety detail.

Arizona highway department doesn't trench base material into traffic lanes, but prefers to spread base material full shoulder-to-shoulder width, proving a 2% crown, to insure good drainage.

Secondary federal-aid road standards were discussed briefly. An Arizona case was described where a county road was redesigned after bids were taken, in order to cut down ditch width, surface yardage and other cost elements and thus reduce cost per mile to a feasible figure. Another instance was given of the high cost of

Mail Inserted Card for Equipment Data

Again this issue of Roads and Streets carries descriptions of many new labor-saving efficiency devices and latest material developments. See our Postwar Parade beginning on page 121, for which a numbered reply card has been inserted to help you request data on items that interest you.

easing curves on secondary roads where cutting across a corner-location means condemning a house.

Bridge Costs

Bridge discussion centered around the difficulty in estimating structural costs. Contractor payrolls in Oregon are up about 50%, due largely to upgrading of labor. An analysis of bridge contractor payroll sheets in that state shows that supervisory labor costs are up from 16% of the job total in 1940 to 25% today. Skilled labor, formerly 35%, is now 61% of the payroll. And common labor is down from 26% to 9%. Tangible labor costs on Oregon bridge contracts are up 62% over 1940. Actually the costs for getting work done are much higher than that, due to lowered efficiency. Lumber is up 240%, sand and gravel 67%, total bridge costs 50 to 67%.

In commenting on these figures, a California representative said that his chief concern is not the present but future costs. Biggest uncertainty by far is the efficiency or output of labor, which is now down to half in some California areas. Further supporting this picture, Arizona reported increase in pile trestle costs from a former $18 to $37 per cu. yd. of concrete, principally due to labor. Concrete which was former low in unbalanced bidding is now on the high side.

Safety Design

The engineering panel gave time to engineering features designed to eliminate accidents. In California a major means is the use of inside storage lanes for left-turn vehicles at important intersections. A median strip of 16 or preferably 17 ft. width is desired, into which an inside turning lane is cut as a means of keeping all through traffic lanes clear. These lanes in conjunction with curbs, raised strips and other means of channelizing, are a cheap substitute where grade separations aren't feasible and for borderline cases where underpasses cannot be built immediately.

In Utah, in line with this thought, intersection accidents were reported to have been cut 90% by better intersection design. Acceleration lanes on the inside next to the median, operating on signals, are the chief means. The question arose, however, as to the safety of curb barriers, which present a hazard because the eye doesn't always recognize them. Painted lines on the pavement are an alternative favored by some.

Robinson Praises Officials

Banquet speaker at the WASHO meeting appropriately was Rep. J. W. Robinson of Utah, who is chairman of the U. S. house of representatives committee on roads and long a national leader in highway legislation. He touched on the fact that we have the funds, the legislation, programs set up, and are set to go except for the serious double shortage of materials and technical manpower. He cautioned the state representatives present that the states are made responsible under the Federal Highway Act of 1944, for urban and secondary phases as well as primary federal-aid roads, and that "necessary operating procedures, systems, programs and priorities must be worked out with the local levels of government."

Members of the recently created Committee on Economics of Highway Construction and Maintenance Methods held their initial session in conjunction with the Salt Lake City meeting. Harry J. Kirk, manager, highway division, Associated General Contractors, Washington, was chairman of the group, which outlined possible committee activities and future course of action.

This committee is under the Highway Research Board, as previously noted in ROADS AND STREETS. Fred Burgraff, of the Board, was in attendance, as was Fred B. Farrell, chief, highway cost section.

Salt Lake City Meeting AASHO-AGC Committee

INCREASED costs and general uncertainties are not confined to highway construction, but are common to all business today, F. W. Parrott, vice president of The Associated General Contractors of America, pointed out at the meeting of the Joint Cooperative Committee of the American Association of State Highway Officials and the AGC held June 10 at Salt Lake City, Utah.

The meeting was held in conjunction with the Western Association of State Highway Officials to study special problems confronting the big highway construction program.

Morris E. DeWitt, Poplar Bluff, Missouri, chairman of the AGC Highway Contractors' Division and AGC co-chairman of the committee, made a brief statement outlining the background of the committee and its activities thus far, and introduced the presiding chairman, R. H. Baldock, State Highway Engineer of Oregon.

Pre-war Overhead Doubled

Mr. Parrott, in speaking before the committee, made the following points:

(1) With respect to the complaint that contractors have in many instances hired engineers away from state highway departments, it is also true that contractors frequently hire men away from other contractors. Mr. Parrott said that the policy of his firm in this respect is first to approach the man's superior before hiring him. Invariably the superior's attitude was not to stand in the way of the employee's getting a better job. The solution for the state highway departments is to pay their engineers enough to meet outside competition for their services.

(2) Regarding cost in general, there has been a considerable increase in the cost of doing business. This condition is not peculiar to highway affairs, but is common to all activities today. Mr. Parrott cited his own recent experience in trying to buy a suit of clothes from the tailor and the latter's reluctance to commit himself to any definite delivery date because of "no linings, no zippers, inadequate help, etc."

Overhead expenses today as compared with conditions before the war have more than doubled, Mr. Parrott said. One case was cited of 25 long distance calls in an effort to expedite the delivery of only one carload of lumber. Similar conditions prevail in delivery of equipment and other commodities.

Many of these increased costs, Mr. Parrott said, are due to factors beyond the contractor's control. It is worth noting that where heretofore the contractor handled these overhead items himself, they are so numerous today that several people must be hired for this purpose.

Mr. Parrott said that low production is not all the fault of inefficient labor. There are so many intangibles, so many bottlenecks, one or more of which are hindering the work 90% of the time, that regardless of their willingness or ability, contractor's crews cannot make headway, he said. This all adds up to a big overhead for lowered production.

Cost of Labor

In introducing the subject of labor costs as affected by the efficiency of men available, Mr. Baldock listed two principal factors contributing to the increased cost of highways: Increase in price; and higher standards of construction in the way of wider and heavier pavements, and other improvements in the interest of permanence, safety and convenience.

He further stated that studies in Oregon for the period 1920 to 1940 revealed that while wages have doubled, unit prices have halved. However, during and since the end of the war, conditions have undergone many changes involving lower production per man-hour of labor, changes complicated by the fact that plant and equipment are showing the hard wear of the war period and other intangible factors that slow down production and increase per unit cost of highway.

The following points were brought out in the discussion:

(1) Unit costs are up on account of certain labor agreement provisions, poor condition of equipment and a lower efficiency of labor, estimated at 50%.

(2) Shortages are worse today than a year ago, and conditions are growing worse. No better conditions are indicated until artificial controls are removed. Price control is ineffective and is proving detrimental to adequate supply in many cases.

(3) The relation between limited work hours and equipment costs was recognized as a new factor in estimating cost. As an example, in one state, the payroll cost for 1946 showed a 52% increase as compared with work on a 36-hour basis in 1940, and a further immediate increase in wages is in prospect.

A special condition in New York State was described wherein the constitution provides for an eight-hour day except in rare instances. Hence, on highway work, the contractor cannot compete for labor with other concerns that are able to work more than eight hours and pay overtime rates. The interpretation of the New York law is such that the contractor cannot work over eight hours even by paying overtime rates.

Engineer-Contractor Relations

It was pointed out that it is going to be more difficult to hire competent engineers because of the low salaries now current on public work.

Instances were cited involving policies in vogue whereby the contractor's bid prices depend not only on the specifications, but also on the particular engineer who will supervise the work, if this can be predetermined.

Recent cases were reported where improvement bonds were not marketable because the phrase "It shall be done to the satisfaction of the engineer" or a similar one in the specifications made the work to be executed indefinite in character and extent. It was asserted that such phrases increased the cost of work by their indefiniteness.

Attention was directed to a statement made at the Oklahoma City meeting of this committee that sometimes cost is affected not so much by the actual wording of the specifications as by an over-enthusiastic enforcement of them. This is not necessarily the result of incompetent or inexperienced inspection, but may be a reflection of the policy in the department.

Changes in Current Contract Provisions

The conference agreed that many changes in specifications such as have been adopted in Missouri would be of mutual benefit to the contractors and to the public in cost reduction. In this instance, work which could be omitted without affecting the stability or usefulness of the highway or structure, was eliminated. The specifications for compaction were reduced from 95% to 90%. Requirements for rubbing concrete supervision were reduced, and changes in grades of steel for reinforcement were allowed.

A representative of one of the western states suggested that in view of the high cost of drainage structures, and as a temporary expedient, it might be well to build the old form of "dip" on secondary roads. Later, when conditions improve, the "dip" could be replaced with a standard structure.

PRA Policy in Contract Awards

It was generally conceded that considerable benefits had been gained after modification of the Public Roads Administration's policy of concurrence in award of contracts so that it no longer operated as a ceiling. Full authority has now been delegated to PRA division engineers in this matter.

J. S. Bright, Deputy Commissioner for Construction, PRA, discussed and explained the agency's policy, and submitted figures showing projects approved, rejected, and pending through May this year.

A threat to the Federal-aid highway program was pointed out in the recent criticism directed at highway legislation by the House Committee on Appropriations. The basis of the highway program is unique, in that authorization of funds under the Federal-aid Highway Act is at the same time a commitment by Congress to appropriate the money.

Some dissatisfaction has been reported in other federal agencies because their programs are not set up on a similar basis.

Secondary Road Program and Access Roads

There is no precedent for the greatly enlarged volume of low cost secondary road projects which may reach an annual total of $300,000,000 under the postwar program.

Committee members expressed the belief that engineers accustomed to designing high cost per mile projects may find it difficult to reorient their approach so as to stretch the same funds over many more miles. It also was thought that some contractors, accustomed to large dollar volume projects during the war, may refrain from bidding, and that county officials accustomed to proceeding with little or no preliminary plans and the use of day labor, will be inclined to continue this method.

Conferees agreed that it would be more economical to carry on these secondary road projects under federal-state supervision, and that the work should be performed by contract.

Dr. L. I. Hewes, chief of Western Headquarters, PRA, asked for suggestions on the use of the contract method in the $15,000,000 program of access roads to government timber stands in connection with the Veterans' Emergency Housing Program. These are to be low-cost-per-mile projects, in some cases to be built under the flag line, and the problem of receiving bids will differ greatly from that on other highway work.

Presiding Chairman Baldock gave the following outline of how to utilize contractors' facilities: (a) clearing by unit bid prices; (b) drainage structures by unit bid prices; (c) needed grading equipment and organization, including operators and supervision to carry forward to adequate standards the proposed roadways on a per day or per hour basis; and (d) surfacing materials on unit bid prices.

It was pointed out that this type of work had been successfully accomplished by this method during the war, and that the same method might be in order for building low cost secondary roads.

Resumption of General Provisions Study

In a letter to the committee, C. M. Hathaway, Illinois Division of High-

(*Continued on page* 103)

(*Continued from page 75*)

in his bid. The public, having paid for compaction, is entitled to just what the contract calls for. We feel certain that the public can receive the benefits of proper compaction at a reasonable price from the contractor only if compliance with the requirements is placed in the hands of well paid and specially trained engineers.

No. 3 on our list involves the technique of performing soils tests in the field. Most of them take too long. We have seen it happen time and again where the location from which the soil sample was taken is buried under several successive layers of fill before the test results are known. In other places we have seen the practice followed of keeping the contractor off of a fill area until the calculations are completed. The ramifications of either situation are readily apparent and are not conducive to low grading cost or to efficiency in grading operations. This is a problem which can only be worked out by the getting together of the theoretical and the practical groups in order to adopt any changes needed to speed up the process. There should be a fine opportunity for the equipment manufacturers to use their ingenuity in devising compact portable kits which will meet with the theoretical requirements. The theoretical group will be making a mistake, in our opinion, if they fail to give proper value to the fact that no matter how correct their deductions are, they have little meaning unless they are completely applicable to field conditions. Field conditions include such items as the human tendency to be a little lazy when the weather gets hot, roads muddy or rough, and the sites of the work just plain hard to get to. We believe the goal should be a test procedure which can be conducted on the spot in about ten or fifteen minutes with a set of equipment which a man can carry by hand. Such a goal should be attainable, particularly if test procedures can be devised whereby all soils types which are likely to be encountered on any one job are catalogued so that the soils engineer can recognize them readily and therefore know without further test what their optimum moisture and theoretical density are. Scientific control of compaction is in its very early stages. It is entirely possible that electronic devices, impact recording machines, or even X-rays may finally prove to be the answer.

The present faults in determining the degree of compaction of a soil sample certainly present a challenge to our technicians and laboratory equipment manufacturers alike.

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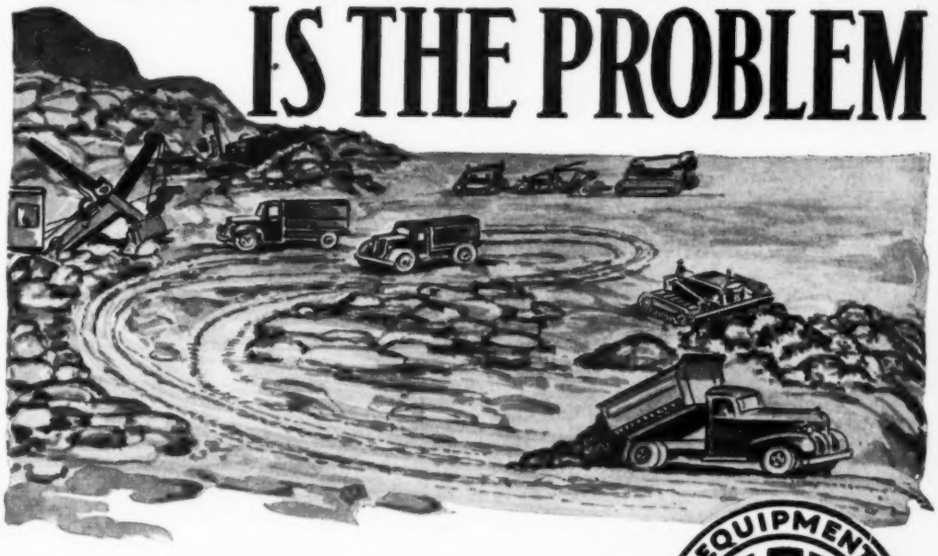

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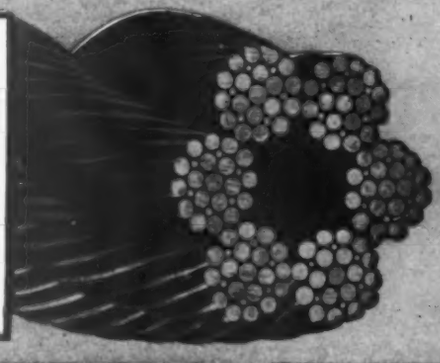

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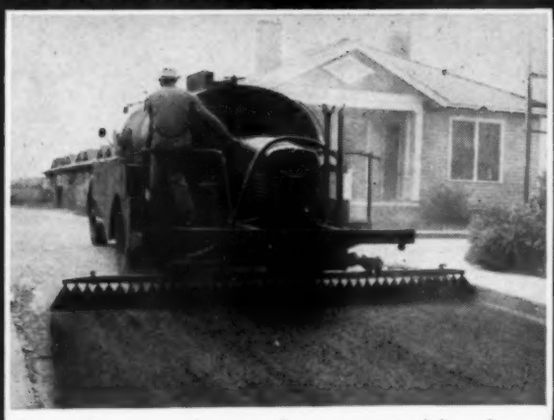

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(*Continued from page* 98)
ways Construction Engineer, stated that he had valuable information gathered over a period of years for use in a study of the general provisions which was authorized at the Oklahoma City meeting. The letter was read by Harry J. Kirk, AGC co-secretary of the committee and manager of the AGC Highway Contractors' Division.

Hal H. Hale, AASHO co-secretary, said a sub-committee to study the general provisions would be appointed at the next meeting of the AASHO executive committee.

H. E. Foreman, managing director of the AGC, and a number of the association's members attended the joint meeting.

Research Set-Up for Subjects Concerning Contractors

First meeting of Committee on Economics of Highway Construction and Maintenance Methods, Department of Economics, Finance and Administration, Highway Research Board

THE first meeting of the Committee on Economics of Highway Construction and Maintenance Methods, which operates under the Department of Economics, Finance and Administration of the Highway Research Board, was held June 11 in Salt Lake City.

The meeting was informal, and members discussed the following subjects: (1) relation of overhead to size of job and safety factors in job management practices; (2) operating characteristics and performance rates of equipment; (3) labor utilization; (4) material requirements; (5) relation of progress rates to specification and design requirements; and (6) maintenance by contract.

Harry J. Kirk, committee chairman, and manager of the Highway Contractors' Division of AGC, suggested that the program for this year should be divided into two parts: immediate objectives upon which definite progress might be reported to the annual meeting of the Highway Research Board, and comprehensive studies requiring long periods of time. Definite assignments will be announced.

PRA Offers Cooperation

The first meeting was devoted primarily to open the subject of committee activity to members and others invited to participate in its work, and to review suggestions on specific subjects to be studied in the future.

H. R. Fairbank, chairman of the Department of Economics, Finance and Administration, and Deputy Commissioner of the Public Roads Administration, has offered PRA's cooperation in the committee's work. By resolution, the committee expressed its appreciation of Mr. Fairbank's offer of the use of PRA's resources.

Scope of Subjects Covered

In the discussion on safety factors, F. W. Parrott, vice president of the AGC, expressed the opinion that safety is the contractor's problem. C. V. Isbell, AGC director, Reno, Nevada, outlined valuable work that safety organizations could do in this field, and Morris E. DeWitt, chairman of the AGC Highway Contractors' Division, reviewed the need for safety publicity.

The committee decided that there is a definite field of activity to undertake on operating characteristics and performance rates of equipment. Concern was expressed regarding the attitude of so-called efficiency experts when on the job, and the possible release of confidential information on operating ratio and unit costs. Mr. Kirk and Fred B. Farrell, chief of PRA's Highway Cost Section, gave assurance that the committee's work was to be viewed as a service primarily in the interest of the contractors.

Mr. Farrell said the PRA investigations on labor utilization would be devoted to such construction and maintenance items that are predominantly labor in nature, such as installation of guard rail and similar direct labor-creating items.

In the discussion of material requirements, it was suggested that a particular subject of study could be conducted upon those refinements of specifications which tend to prohibit the use of local materials, and that greater alertness should be stimulated in the use of local materials where available.

The following items under the subject of relation of progress rates to specification and design requirements were considered possible subjects for future study: (a) pavement joints: justification from standpoint of initial construction costs; (b) rounded slopes requiring considerable use of labor; (c) "sand-paper" finishing of slopes requiring considerable use of labor; (d) rubbing of concrete requiring use of labor and resulting in loss in wearing ability; (e) standardization of types of small drainage structures permitting re-use of forms; (f) elimination of headwalls on down-stream end of culverts; (g) ditch width (to be suited to available equipment).

Mr. DeWitt suggested that further study of maintenance work by contract be conducted, and stated that considerable success and economy was achieved in Illinois by letting certain maintenance work by contract. Several members discussed this subject, and it was generally agreed that it was practical to contract work for which accurate estimates and specifications can be made.

Those attending the meeting were: H. J. Kirk, M. E. DeWitt, F. B. Farrell, H. E. Foreman, managing director of the AGC; Carl E. Nelson, AGC director, Logan, Utah; Dan J. Cavanaugh, AGC director, Twin Falls, Idaho; F. Bruggraf, assistant director, Highway Research Board; H. L. Royden, president of the Arizona Chapter of the AGC: C. V. Isbell; Charles L. Hill, manager of the Nevada Chapter of the AGC; F. W. Parrott; T. H. Dennis, maintenance engineer, California; Jed N. Robinson, construction engineer, Texas State Highway Department.

Communications from five individuals who could not attend were read: George W. McAlpin, West Virginia State Road Commission; Edward O. Earl, Tucson, Arizona; H. A. Radzikowski, PRA; R. M. Whitton, maintenance engineer, Missouri State Highway Commission; and J. R. Wininger, Portland, Oregon, vice chairman of the AGC Highway Contractors' Division.

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Highway Freight Increases

The volume of freight transported by motor carriers in April increased 5.3 percent over March and 1.0 percent over April of last year, according to statistics compiled by the Department of Research of American Trucking Associations, Inc.

★ Considerable hand shoveling is always necessary in downtown areas of Washington, D. C., where de-icing chemicals are not permitted because of underground traction installations

Snow and Ice Control

in the District of Columbia

Data assembled to inform local citizens on the District's snow program, its scope, its limitations, and how the public can cooperate to make it effective

By William A. Xanten

Supervisor City Refuse Division, Engineering Dept., District of Columbia, Washington, D. C.

THE snow program of the District of Columbia Engineering Department is comprised of plowing of snow from main thoroughfares and boulevards (308 miles); physical removal of the snow by hauling from the major business areas only (about 25 miles of street); the progressive opening of crosswalks, catch basins and fire hydrants, and the sanding of the more important hills and intersections. The combined forces of the City Refuse Division, Highway Department, Sewer Division, and Water Division are used, supplemented by extra laborers and hired trucks. Expenditures depending on winter severity, can vary from $10,000 to $200,000 or more annually, based on the limitation of available funds. The major expense is for the hauling of snow from the business streets, principally in the heart of the downtown area, but including several outlying business districts, bridges and important intersections.

"Plow Miles," True Measure of Job

The plowing program is confined to slightly over 300 miles of arterial and heavily-travelled streets. This is a task of greater magnitude than is expressed by the linear mileage, as explained below, and all available equipment (120 plows) must be assigned to these important thoroughfares for the duration of a storm.

The necessity of plowing from two to four or more lanes each way on the wide streets, in addition to replowing those lanes as snow continues to fall, would perhaps argue for an expression such as "plow miles" rather than "miles" of streets, in order to present a more understandable picture of the task involved. In other words, the 308 miles on the plowing schedules require travel in excess of 1,800 miles to clear the entire roadway once. In the event of a 10-in. snow falling at the rate of 1 in. per hour, and assuming each route is covered once every two hours, it would be necessary for the plows to travel 9,000 miles during the 10-hour period of the snow fall in order to keep the routes open full width.

Hauling Program

Complete removal of snow from business districts by loading and hauling in trucks (and disposing into sewer manholes and the river), ordinarily requires about 1,550 men, 250 trucks and all available mechanical loaders. The loaders, now numbering 15, work mainly during the traffic-free hours during the night and for a number of shifts, depending on the depth and severity of the storm.

Indicating the size of this job, a 10-in. storm will require hauling of 300,000 cu. yds. or 30,000 truckloads, necessitating six shifts and an expenditure of about $50,000.

White Wing Work

As part of the snow hauling program the regular white wing forces (some 185 men) are assigned the task to improve conditions in their respective areas throughout the city. Their work consists of clearing snow from crosswalks, catch basins, fire hydrants and clearing and hauling snow from important intersections, bridges and necessary places, to the extent that it is possible by spreading their limited forces over the 800 miles of streets. These forces are also supplemented by extra hired men after the need for extra labor for supplementing the hauling gangs has been satisfied.

Sanding Program

Sanding equipment proceeds over scheduled routes of streets, selected in consideration of the presence of hills and the volume of traffic. In addition to scheduled routes, requests for special sanding are responded to as promptly as available forces permit. This request service is maintained 24 hours a day during freezing weather.

In addition to the sanding program of the District Government it should be pointed out that the Capital Transit Company operates an equally important sanding program over its bus routes. The U. S. Park Service maintains a force for the sanding of roads within the park area.

Answers to Numerous Questions Frequently Asked

Q. Why aren't all streets plowed?

A. The plowing of residential streets is undertaken as a secondary program only in outlying areas and in special cases, because there is a serious question of the desirability of plowing the relatively narrow residential streets with parked cars on either side, since this is frequently followed by criticism and demands for hauling of snow from around parked cars and driveway entrances, crosswalks, etc. Also, on the conclusion of plowing, most of the equipment operators and other forces are needed for the snow hauling program and are so assigned after a minimum interval of rest.

Q. Why is snow not hauled from all streets, or all plowed streets?

A. To haul snow from the entire 800 miles of streets in the city at large would require an expenditure and a program more than thirty times as great as the present program. In addition to the expenditure, the number of trucks and labor needed for such increased work would not be available. Snow disposal stations, the supervisory forces, and other facilities would have to be expanded in like proportion. From this it may be seen why the practice in virtually all large American cities is to remove snow only from congested areas.

Q. What is the purpose of the ban on parking from 2:00 a.m. to 8:00 a.m.

A. The purpose of the ban on parking from 2:00 to 8:00 a.m. on some 81 miles of arterial streets has been generally misunderstood. It is not for the physical removal of snow by hauling, for as explained above, the cost of removal on such a scale would be prohibitive; but rather it is to make it possible to plow snow up on the curb so as to open to traffic the full width of the street. Without this ban a serious traffic condition would exist following a heavy snow due to the narrowed width of roadway left for traffic after bulky windrows of snow have been placed against automobiles parked at the curb.

Q. Why are automobiles plowed in at the curb and windrows of snow left across driveways?

A. Plowing cannot be stopped whenever a parked automobile is encountered or a driveway is approached, as this would leave a windrow of snow greater than the width of the plow extending out into the street causing a traffic obstruction and hazard.

Q. Does the city clean sidewalks, and if not, why?

A. Generally, no sidewalk cleaning is undertaken by the city, with the exception of limited areas in business sections from which snow is scheduled for hauling for accommodations of the general public, from bridges and from sidewalks cleaned by the U. S. Park Service around public parks and buildngs. It is physically impossible for the city to undertake to remove snow from the hundreds of miles of sidewalks in the city, when it is realized that all available forces are engaged on the snow program of sanding, plowing and hauling from a limited mileage of streets in the city.

Q. Why are alleys not plowed?

A. Alleys are not plowed for several reasons. The bulk or size of the plowing equipment when fitted with plow blades makes it impossible to negotiate most alleys. Basically, a snow plow is a displacement device and must have a suitable marginal strip along the lane to be plowed to receive the resultant windrow of snow. In alleys there is no such space, generally.

Q. Why are refuse collections disrupted during a snow storm?

A. In emergency operations it is essential to have a well-controlled and organized force of experienced laborers and equipment operators, together with their foremen, for prompt and dependable work. The snow program requires the use of the personnel and truck equipment of the Street Cleaning, Refuse, Highway, Sewer and Water Divisions as the main source of snow fighters; extra men and trucks are engaged as necessary and when available. This is standard practice in all American cities.

Q. Why is salt not used to a greater extent in Washington?

A. Sodium or calcium chloride is not generally used to combat icy conditions in Washington because its use results in the short-circuiting of the underground third rail of the transit system. Washington is virtually unique in this respect, although in portions of New York City it is likewise found impracticable to use salt. This material is used, however, on outlying streets sufficiently remote from underground third rail to assure

★ A fleet of vertical-lift scoops is an indispensable part of the Washington, D. C., snow fleet

no salt solution will be tracked ahead to give trouble.

Q. Why not flush snow and slush into sewers with water?

A. Flushing or hosing of snow and slush off the streets is not attempted because the drainage system of Washington is equipped with trapped catch basins which, being designed to hold solids and prevent their entry into the sewer (as well as to prevent the escape of sewer gases), quickly fill up with slush and become clogged. Direct sewer inlets exist in some cities, and when temperatures are favorable this very satisfactory flushing method is utilized.

Q. How and where is the removed snow disposed of?

A. By dumping into manholes, some of which have been specially constructed for snow disposal, directly over active flowing sewers, by dumping into the river, and by dumping on city dumps.

Q. Why are brooms not used for snow removal?

A. Revolving brooms mounted on automotive units are used in a few cities where a full complement of snow equipment is owned. For very light snows, such as cannot effectively be skimmed off by the plows, these brooms are of service, but their effectiveness depends upon the ability to sweep off the snow before traffic packs it. Consequently, it would be necessary to purchase a large number of such brooms in order to sweep the city's arteries in event of light snowstorms. It is believed that available funds are better applied to the purchase of equipment for heavy storms.

Q. Are streets sanded during a snowfall?

A. Streets are sanded in conjunction with plowing operations. However, during a heavy fall of snow the use of abrasives is not as effective as would be the use of either sodium or calcium chloride.

Q. Why is sand not removed promptly from the streets when icy conditions no longer exist?

A. Thousands of tons of sand are spread on the streets during the winter and every effort is made to remove the sand as rapidly as possible by the regular street cleaning forces. Because of the large quantities used, however, the winter-time street cleaning frequency coverage is seriously affected.

Q. Why is sand not used over again?

A. Most of the abrasive qualities of the sand are lost after once being used. Also, because of its cheap cost, there would be little economy in rehandling for this purpose on a large scale.

Q. Why not flush the sand into catch basins with water after it has served its purpose?

A. The sand would cause the catch basins to become clogged and disrupt the drainage system of the city.

Q. How much snow can be expected in Washington?

A. In the past 43 years, snow has fallen on 416 occasions, or about ten times a year. Of these, there were 135 snow storms of a depth greater than 2 inches, averaging about three a year. In some years virtually no snow has fallen (2.5 in. in 1930-31) and in other years as many as eight heavy storms have occurred (44.5 in. in 1921-22; 26 in. on Jan. 27, 1922, alone). The average annual snowfall is 20.9 inches.

How the Public Can Cooperate

The task of enabling vehicular and pedestrian traffic to continue moving normally during and after a snow storm has been shown to be a huge task and one which, even at large and unreasonable expenditure, cannot be totally accomplished for lack of sufficient equipment and man power. With a reasonable expenditure and combined effort of all branches of the city forces and such extra equipment and labor available, however, a program has been planned to reduce the inconvenience and to maintain traffic movement as nearly normal as practicable. However, the result of the work scheduled to be done is dependent largely upon the co-operation that is received from the general public. Such co-operation is of the utmost importance for the benefit of yourself and others, and can best be achieved by careful observance of the following:

1. *Clean your sidewalks promptly.*
2. When cleaning sidewalks or driveways, or digging out "plowed-in" automobiles DO NOT SHOVEL SNOW INTO GUTTERS OR STREETS where it will block traffic or interfere with subsequent drainage. PILE SNOW ON THE CURB (in tree box spaces and around trees) OR ON THE FRONT LAWN.
3. In time of *heavy snow* do not attempt to drive your car without chains during the storm. Chaotic condtiions usually follow such attempts, in that stranded automobiles in large numbers can effectively block plowing operations.
4. Snow from private property (gas stations, parking lots, barbecues, etc.) should be piled on private property and not thrown on public space.

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All-Welded Bridge

New Jersey's first all-welded bridge to be built by the state highway department was dedicated recently. Located at a beach point near Atlantic City, it consists of a steel I-beam deck and H-pile bents, supporting a concrete deck. Piles are incased in concrete filled steel shells to a point above the water line, and protected against sea water action by a bituminous coating on upward.

While on this subject, it is noted that the New York state department of public works has an all-welded bridge scheduled for construction in its Thruway program, the deck of which will have an area of nearly two acres.

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Veteran Texas Road Builders Honored

Sixty-six veteran Texas road builders who completed more than 25 years of service with the Texas State Highway Department were recently awarded gold pins and scrolls by Chairman John S. Redditt on behalf of the state highway commission.

Most of the old-timers were on hand for a special ceremony held during the 20th annual highway short course at College Station, Texas.

Topping the list in length of service was J. W. "Pa" Puckett, district engineer at Pharr, who entered the department's service a few weeks after it was created back in 1917. He will round out 29 years this month.

Coming in for a close second was Miss Bessie Bergstrom, chief clerk of the Austin registration division, who is only seven weeks behind Mr. Puckett.

Honors for third place go to J. B. "Johnnie" Nabers, district engineer at Childress, who completed 28 years of service last March.

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First New York Thruway Contracts Let

New York state's much heralded Thruway program, which will link Buffalo, Albany, the New York City area and intervening cities with multilane limited access highways, has taken tangible form with the letting of two initial contractors. D. W. Winkleman Inc., and A. S. Wickstrom, both of Syracuse, have one contract for 3.46 miles at $593,000 for preliminary grading and structures. The Grandview Company, Mt. Vernon, N. Y., was awarded 2.81 miles at $430,000. These contracts, which do not include paving and finishing details, give an idea of the per-mile cost of the new order of highway needed to inter-connect larger cities.

Fastest Concrete Paving Jobs also Best Quality

reveals Calif. construction progress records

This author notes need for granular insulating course between worn concrete pavements and bituminous resurfaces; cites elimination of expansion joints in concrete; also gives data on other pavement types

By Earl Withycombe

Assistant Construction Engineer, California Division of Highways and Public Works

THE year 1945 marks the smallest mileage of high type pavement constructed by the Division of Highways since 1924. Out of a total of 427.3 miles of highway construction, only 11.5 miles were built of portland cement concrete or asphalt concrete.

The total mileage of Federal access road construction was also greatly reduced in 1945. The entire program totaled 51.0 miles, of which 7.4 miles was high type, the remainder low type bituminous.

The expenditure of State funds went almost exclusively to finance the repair of existing pavements with low type bituminous surfaces. Some 416.4 miles of this work were constructed, of which 337.5 miles were plant-mixed and 4.7 miles were armor coat, the remainder being road-mixed bituminous construction. Increasing amounts of cushion courses were used to cover concrete pavements which are subject to rocking and pumping action.

Insulating Course Needed

The performance of thin bituminous blankets laid in the past directly on such pavements has demonstrated the need of an insulating course between the bituminous blanket and the moving foundation. Selected rocky granular material, crushed rock and crusher run are used for these cushion courses and are generally six inches thick. This type of construction has been under traffic in heavily traveled sections for a period of three years, and in no instance has the result of the rocking slabs been transferred through the cushion course sufficiently to crack the bituminous surface.

P. C. Concrete Data

Information gained from the study of California pavements now in progress under the supervision of the Materials and Research Department, and from experience with experimental sections installed in this and other states, has led the department to make a radical departure from the conventional design of concrete pavements. In the future expansion joints will be eliminated entirely except for the junction of pavement and bridge end.

The practice of construction in single lane widths will be continued, and the longitudinal joint will be provided with load transfer by means of tongue and groove with tie bolts at 30-in. intervals. This same construction type will be used at transverse contact joints. To facilitate installation in the separate slabs, the tie bolts will be joined together along the joint face by means of threaded couplers imbedded in the first strip poured. Transverse weakened plane joints will be installed in the first strip poured. Transverse weakened plane joints will be installed at 15-foot intervals. The slab will be of uniform thickness with an 8-in. minimum depth, and the concrete will carry five sacks of cement to the cubic yard.

During 1945 the design adopted in 1942, which consisted of eliminating steel and dowels, and by thickening slab at expansion joints, for war construction, was used, except that the largest project for the season, in San Diego County, was constructed without expansion joints.

The principal portland cement concrete pavement laid during 1945 was in San Diego County, being a 4.5-mile access project. Basich Bros. were the contractors, H. F. Caton, resident engineer, and W. Cattell, the street asistant. This contract had the *highest average daily output* of concrete during the year, 371.7 cu. yd. per 8-hour day, the *highest average compressive strength* of concrete, 4,428 psi.; and the *smoothest riding quality* of surface with an average roughness index of 7.2 in. per mile.

The average daily concrete output per project for the State in 1945 was 236.1 cu. yd. as compared to 425.8 cu. yd. in 1944. The average strength of 28-day breaks was 4101 psi. in 1945, compared to 3876 psi. in 1944. The average surface smoothness for concrete pavement was 14.2 in. per mile in 1945 compared to 10.1 in 1944.

Asphalt Concrete Data

All of the 1945 bituminous construction was laid by means of self-propelled finishing machines of the type not requiring the use of side forms. Projects were short—0.2 to 1.4 miles.

An experimental section 0.7 mile in length was laid over rocking concrete slabs, using a 2 in. course of open-graded mix similar to the old binder course formerly used under sheet asphalt pavement, and topped with a 2-in course of asphalt concrete. Asphalt with a penetration of 85 to 100 was used in both courses. It was thought that this construction might prevent cracking and spalling of the surface course from foundation movement.

Summarized from an article in "California Highways and Public Works."

The highest average daily output of asphalt concrete during 1945 was on a job in Vallejo, where an average of 666.6 tons per 8-hour day were laid by Sheldon Oil Company, contractor, G. R. Hubbard, resident engineer, and G. R. Barry, street assistant. The average daily output per project for the State was 341.2 tons, compared to 392 tons in 1944.

The highest stability of surface mixture was obtained on a contract in San Mateo County, with an average of 51%. Union Paving Company was the contractor, W. G. Remington, resident engineer, and C. W. Snyder, plant assistant. The State average was 39% compared to 42.8% in 1944.

The record for surface smoothness was made on a job in Alameda County with an average roughness index of 14.5 in. per mile. Louis Biasotti and Son were contractors, G. L. Beckwith, resident engineer, and C. Hamma, street assistant. The average for the State was 24.7 in. as compared to 18.2 in. in 1944.

Bituminous Treated Surfaces

A total of 416.4 miles of this type of construction was laid in 1945, of which 411.7 miles was the mixed type and 4.7 miles, armor coat. Of the mixed type, only 18% was constructed by the road mixed method, and 82% was mixed through a plant.

Of the 337.5 miles of plant-mixed bituminous surfacing laid in 1945, 28.5% was constructed with open-graded mix. This mix is somewhat new to the Division of Highways, although it has been used by other road-building agencies in California for some years. It consists of practically the same grading of coarse aggregate as the dense-graded mixtures, with the material finer than the No. 8 sieve reduced to a negligible amount. The amount of asphalt is approximately the same in both mixes. The cost of producing aggregate for the open-graded mix is somewhat greater than for the dense-graded mixture, but the bids for open-graded mix in 1945 averaged only 110% of the average cost for dense-graded mix.

The 1945 record for smoothness of riding surface on plant-mixed surfacing was shared by two projects: one in Los Angeles and Orange Counties, Griffith Company, contractor, C. P. Montgomery, resident engineer; and Contract 9VC2, Mojave to Cinco, Oilfields Trucking Company, contractor, R. F. Johnson, resident engineer; each contract having an average of 9.7 in. per mile. The average for the State was 19.5 in. per mile, compared to 16.8 in 1944.

The record for smoothness of riding surface on road-mixed surfacing was obtained north of Victorville to Victorville Airport, Basich Bros. Construction Company, contractor, E. A. Bannister, resident engineer, with 17.4 in. per mile. The average for the State in 1945 was 31.2 in. per mile, as compared to 32.9 in. in 1944.

The record for armor coat surfaces was made on Contract 1TC9, Longvale to Laytonville, A. R. McEwen, contractor, E. F. Richardson, resident engineer, with an average of 37.8 in. per mile. The State average in 1945 was 70.4 in. per mile, as compared to 48.3 in. in 1944.

Traffic Jams Unsnarled by Airplane

Recently police resorted to a radio equipped plane to help keep traffic into New York City moving on a Monday morning following a 4-day holiday week-end. It is believed to be the first use of a plane for this purpose since before the war.

According to a newspaper account, the plane flew over the city, enabling observers to spot traffic snarls. Information on their location was relayed to the police telegraph. The location of traffic jams was then radioed to motorists so that they could take other routes and thus avoid further tie-ups.

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New Truck Laws

On the state legislative front Governor of Massachusetts approved H. 1890 increasing maximum length of tractor-semi-trailer from 40 to 45 ft.; also H. 1891 increasing weight for two axle vehicles from 30,000 to 36,000 lbs., and three axle vehicles and tractor-semi-trailers from 40,000 to 50,000 lbs. Bill has been introduced in Louisiana, H. 250 permitting 40 ft. length for buses with three axles, increasing length of tractor-semi-trailers from 40 to 45 ft. and other combinations from 45 to 60 ft. Missouri S. 487 also increases length of vehicles and combinations in accordance with American Association of State Highway Official's recommendations and providing gross weights the same as the table recommended by AASHO.

Portland Cement Concrete Pavement Records for 1945

Location	Contractor	Resident Engineer	Street Assistant	Average Cu. Yds. Laid Per Day	Average Strength, 28 Days, Lbs. Per Sq. In.	Roughness Index, Ins. Per Mile
Marin, Entrance to Hamilton Field	A. G. Raisch Co.	W. A. Rice	D. N. Sapp	146.2	3991	27.3
Alameda, University Ave.-El Cerrito Hill Overhead, Berkeley, Albany	Lee J. Immel	F. W. Montell	L. G. Marshall	119.6	3245	17.7
San Diego, Palm Ave.-Coronado (por.)	Basich Bros. Const. Co.	H. F. Caton	W. Cattell	371.7	4428	7.2
San Diego, Pacific Highway-Washington St.	Ralph O. Dixon	J. F. Jorgensen	G. S. Kibby	172.3	3713	42.7
			Averages	236.1	4101	14.2

Asphalt Concrete Pavement Records for 1945

Location	Contractor	Resident Engineer	Street Assistant	Average Tons Laid Per Day	Average Stability of Surf. Mix. in %	Roughness Index, Ins. Per Mile
Marin, Entrance to Hamilton Field	A. G. Raisch Co.	W. A. Rice	D. N. Sapp	295.8	48	50.0
San Mateo, San Bruno, Sneath Lane-Forest Lane	Union Paving Co.	W. G. Remington	E. J. Carter	359.2	51	22.2
Alameda, University Ave.-El Cerrito Hill Overhead, Berkeley, Albany	Lee J. Immel	F. W. Montell	W. Hegy	490.2	30	15.0
Alameda, Contra Costa-El Cerrito, Hill Overhead-Rte. 14, Albany, Richmond	Louis Biasotti & Son	G. L. Beckwith	C. Hamma	243.9	39	14.5
Santa Barbara, San Luis Obispo-Zaca-Pismo Beach	Brown, Doko & Baun	J. C. Adams	M. Chapman	298.7	43	20.2
Solano, Tennessee and Georgia Sts., Vallejo-Route 7	Sheldon Oil Co.	G. R. Hubbard	G. R. Barry	666.6	35	42.2
San Diego, Pacific Highway-Washington St.	Ralph O. Dixson	J. F. Jorgensen	M. C. Barron	200.0	47	41.7
			Averages	341.2	39	24.7

Maintenance Costs and Methods

as reported to Highway Research Board Committee

Serious lack of cost data and disparity between the highest and lowest costs of performing maintenance and repairs in the various states, is noted in this progress report of the Committee on Highway Maintenance Costs and Operating Methods of the Highway Research Board. Report was prepared under direction of W. H. Root, Chairman of the Board's Department of Maintenance, and presented at the Board's annual meeting at Oklahoma City

By J. S. Bright
Deputy Commissioner, Public Roads Administration, Washington, D. C.

ROAD maintenance to preserve the nation's streets and highways cost $659,000,000 in 1941, operations throughout the United States. Analysis over a period of years on representative road sections discloses that on the average 45% of maintenance expenditures is direct labor, 21% for materials, 25% for equipment and 9% for overhead. Total expenditures for 1942 and subsequent years reflect only a partial performance of necessary highway maintenance due to manpower, equipment and material limitations. The 1941 cost of maintenance is, therefore, to be considered the minimum expenditure to meet present requirements. A general uptrend of prices and the essential work of overcoming the accumulation of deferred maintenance work will be contributing factors in making additional expenditures.

Revaluing Needed

The expenditure of nearly three-quarters of a billion dollars on maintenance operations per year emphasizes the need for revaluing in the postwar years the repair practices used to arrive at common results and the selection of the most efficient methods. Such selections should be based on comparisons between states of unit costs, analysis of the maintenance operations and an appraisal of the effectiveness and durability of the work performed.

As a beginning, in an effort to arrive at comparative costs, field maintenance engineers of the Public Roads Administration were asked to secure from state highway departments such data for individual maintenance operations on portland cement concrete pavements as were readily available. A description was also requested of the materials and practices on the operations studied. This progress report furnishes the results of the survey and also an analysis of costs on several other maintenance operations.

Only 17 of the 48 states had cost analyses readily available for specific maintenance operations on concrete pavements. In these reports there was a lack of uniformity in the units used in cost analysis. The data presented in this report should focus attention on the need for adoption of uniform cost units for maintenance operations and encourage maintenance organizations to compare their unit costs with those of other organizations. It will permit maintenance engineers who develop unit costs during 1946 to compare their costs with those in this report for a determination as to whether economy in method is being achieved.

Lack of Data

All 48 States were requested to supply costs and descriptions of methods for: (a) Joint and crack filling; (b) Patching concrete with bituminous material; (c) Patching concrete with concrete; (d) Mud-jacking operations.

Of the 17 States which responded with data, eight submitted costs on item (a), seven on item (b), seven on item (c) and five on item (d). Only one State submitted costs on all four items.

Joint and Crack Filling

Data submitted by the eight states for joint and crack filling disclosed a wide variation in unit costs—the lowest being $8.64 per road mile and the highest $138.89. Unit costs of this item on the basis of length of joints and cracks would have furnished a more accurate comparison but these were available in only a few instances. The complete tabulation of costs submitted by the eight highway departments are as follows:

Cost per road mile: (1) $50 to $85; (2) $25.00; (3) $138.89; (4) $33.96; (5) $39.13; (6) $8.64 (machine method), $15.90 (hand method); (7) $32.77; (8) $35.00 (pavements up to ten years old), $60.00 (pavements ten years and older).

(1) The cost of $50 to $85 per mile varies with the number of pavement joints and cracks per mile of road. The cost per lineal foot of joint and crack filling varied from ½ to ⅝ cents. The material used was a mixture of 30% 90-95 (SC6) and 70% of 31-40 air-blown asphalt. The filler was heated to a temperature of 300°-325°F. and poured into the joints and cracks through metal cones. A crew of from four to six men was generally used for the work.

(2) The cost of $25 per mile for joint and crack filling was an average based on work performed on 761 miles of concrete pavement. Material used for the filling consisted of an 85-100 penetration asphalt cement mixed with 15 to 25% by weight of mineral filler. Loose material in joints was removed before filling. Cost per lineal foot of filling was not available.

(3) The $138.89 cost per mile was an average on eight sections of pavement totaling 112 miles. The asphalt-mineral filler used in this work consisted of a 50 to 60% homogeneous mixture of mineral with an asphalt having a penetration of 50-65.

(4) The cost of $33.96 per mile was reported by the fourth state as an average on 221 miles of pavement. The description of the filler was briefly reported as an asphaltic cold patch material.

(5) The cost of $39.13 per mile was the average cost of joint and crack filling on 6,034 miles of concrete pavement. The asphalt filler had a 50-60 pen. and was poured at a temperature of not less than 225° nor more than 275° F.

(6) The cost per mile of $8.64 and $15.90 are average costs reported from records kept on machine pouring and hand pouring methods, respectively. Savings of about 25% in material with practically no waste and neater work were reported as being accomplished with smaller operating crews when crack filling machines were employed. The material used was an asphalt of 85-130 pen. in which was incorporated 15-25% by weight of mineral flour of such fineness that no appreciable separation of the mixture occurred while being maintained in a liquid state. The material was heated for proper thinning in preparation for the pouring in cracks but not to exceed 375° F. Cost per lineal foot of filling was not available.

(7) The cost of $32.77 per road mile was based on records kept on eight projects totaling 97 miles of pavement located within one maintenance district. The cost included $20.79 for labor and equipment rental and $11.98 for material. Filling was estimated to cost one-third of a cent per foot of joint or crack. The material used was asphalt crack filler of a 100-120 pen.

(8) The cost of $35 per mile was based on pavements up to ten years of age, while the $60 cost was based on pavements over ten years old. The cost per lineal foot of crack or joint was estimated to be one-fourth of a cent.

Two types of joint filler were used, one being RC-5 having a penetration of 80-120 and the other conforming to the AASHO specification M-18.

(b)

Bituminous Patching Concrete

Costs reported by the seven states for bituminous patching ranged from $0.25 to $1 per sq. yd. Costs were also reported on a per-mile basis.

The lowest cost per square yard reported for bituminous patching resulted from the use of a penetration type emulsion. Fine or medium screenings were used on shallow patches and ⅜—or ½ in. crushed rock on deeper patching. In performing the work the area to be patched was first broomed, a light tack coat of emulsion applied and enough crushed rock or screenings spread to bring the depression to grade. An application of 1/6 to 1/5 gal. of emulsion per sq. yd. was then applied, followed by sanding and rolling.

No indication was given as to the method or materials used in the patching work which cost $1 per sq. yd., other than patches were of an oil mulch type.

Two reports on a per-mile basis indicated costs of $25.12 and $99.09—the former being based on 221 miles and the latter on 6,832 miles of highways. The method and materials used were not described for the lower cost. Asphalt cut-back, asphalt emulsion and plant mixed bituminous concrete were the materials used for the patching work costing $99.09 per mile.

(c)

Patching with P. C. Concrete

Reports from five states show a range in costs for patching with concrete from $4 to $6.70 per sq. yd.

Data compiled by one state on replacing 19,952 sq. yd. of concrete by

In Days of Old

Roads and Roadbuilding in Years Gone by

Photo from the Bettmann Archive

★ Before the introduction of traffic laws! A traffic jam in London before the introduction of the automobile. Engraving by Gustav Dore from his book on London, published in 1852

"SUPERIOR TO ANYTHING WE HAVE YET USED"

That's Mr. Hill's description of his Mack trucks.

In the first six months of service, the three Mack EHX's, purchased by **Hill & Combs, General Contractors, San Antonio, Texas,** poured 22,500 cubic yards of concrete . . . operating through heavy, waxy mud, with Mack hauling the load!

Mr. Hill also writes—"We found these trucks plowed through to deliver the load *whenever* and *wherever* it was required."

This owner-praise is not new for Mack . . . but it again spots Mack doing a specific job—a tough job—efficiently, and at minimum cost. Check Mack for service and long-run economy before you buy your next truck!

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TRUCKS
FOR EVERY PURPOSE

Performance Counts!

Mack Trucks, Inc., Empire State Building, New York 1, New York. Factories at Allentown, Pa.; Plainfield, N. J.; New Brunswick, N. J.; Long Island City, N. Y. Factory branches and dealers in all principal cities for service and parts.

state forces disclosed a unit cost of $5.14 per sq. yd. Similar work by contract in replacing 1,309 sq. yd. cost $6.70 per sq. yd. The concrete mix was 1:1½:2 (by volume) using 1½-in. coarse aggregate and a 1:3 mix when using 50-50 pit-run aggregate. The concrete was mixed for two minutes and consolidated by mechanical vibrator. Work was confined to half of the slab width and all patches were permitted to cure for 24 hours under the protection of burlap.

In another state a total of 43,959 sq. yd. of concrete replacement was completed at an average unit cost of $4.68. Three methods were employed on this work. Part of the concrete was hauled as dry batch and mixed at the site, part was mixed at a central plant and hauled as wet batch and part was proportioned at a central plant and hauled in transit mixers. Practically all mixing and proportioning were performed by state forces, although in a few instances ready-mixed concrete was purchased from a commercial firm which made delivery.

Cost data kept on concrete replacement work performed during 1944 and 1945 in a mid-western state was summarized as follows:

	Per sq. yd.
Patch not more than 5 sq. yd. in one lane	$6.00
Patch over 5 and less than 15 sq. yd. in one lane	5.25
Patch over 15 and less than 40 yd. in one lane	4.90
Patch over 40 sq. yd.	4.78

These costs include removal of old pavement and storing debris within two miles of the site, curing, and maintenance of barricades, signs and lights, but do not include reinforcing, removal of subgrade or dowels. The concrete used was of a sand-gravel mix with seven sacks of cement per cubic yard.

Another state reported that 3,316 sq. yd. of concrete were removed and replaced at a cost of $5.02 per sq. yd. Similar work by maintenance contract has averaged $5.50 per sq. yd.

The remaining unit cost of $4 per sq. yd. was obtained from data kept by a western state on 18-ft. pavements over ten years of age. This cost is an average figure for replacing pavements of 6 to 9 in. in thickness. The cost of breaking old concrete which was included in the $4 unit cost averaged $1 per sq. yd.

Unit costs were not available for placing shallow concrete patches and only one state reported using this type of patch. In the method described, all disintegrated concrete was removed and a solution of one part hydrochloric acid and four parts water was brushed onto the concrete. After five minutes the solution was flushed off with water and a mix of neat cement was brushed onto the surface of the old concrete. The concrete patch was then laid. The mix consisted of one part air-entrained (vinsol resin) cement, two parts sand and three parts trap rock. In very shallow patching ½ in. trap rock was used for aggregate. In deeper patching the coarse aggregate was made up of 60% of 1¼-in. stone and 20% of ½-in. stone.

Mud-Jacking Operations

Of five states reporting mud-jacking costs, two were based on the square yard of surface raised to normal level, one was on a per-mile of road basis, one was on per cubic yard of material and one on per gallon of material placed under the surface.

One state employs two mud-jacking crews to repair all concrete pavement settlements within the state. The annual cost for work is about $25,000 for the 761 miles of pavement. In doing mud-jacking, special attention is given to settlements of recently laid concrete but no lifting is performed unless the settlement exceeds two inches. The amount that slabs have been raised varied from 2 to 8 in. The cost varied from about $1 to $4 per sq. yd. depending upon the amount of lift. In 1942 the average lift was 3 in. and in 1943 it was 5 in., the costs being $1.58 and $2.56 per sq. yd., respectively. The aggregate used in the slurry mix was earth which would hold water under pressure of 500 psi., such as loam, topsoil, hardpan or clay. Materials were required to pass a ⅝-in. mesh screen and contain not more than 5% of sand. Two sacks of cement per cubic yard were used in the mix and additional cement was added where the subgrade was wet.

Mud-jacking costs kept in repairing 50 miles of concrete pavement in another state indicated an average cost per mile of $117.61. More detailed data relative to the extent of the operations were not available.

The cost of treating 21,200 sq. yd. of concrete pavement in one of the eastern states averaged $0.24. A slurry of topsoil, cement, water and asphalt was used, the total amounts being 105 cu. yd. of topsoil, 275 sacks of cement and 300 gal. of asphalt. About 1,800 holes were required for the treatment. The crew consisted of seven men.

A central state reported that during 1944 a total of 9,455 cu. yd. of material were placed under pavements as preventive and corrective work at an average cost of $9.24. Usually no attempt was made to raise the pavement from its settled position. It is the policy in the state merely to fill the voids under the slab to reduce deflection and then restore riding qualities with a bituminous top course. Mud-jacking work was performed by an eight-man crew consisting of a foreman, mud-jack operator, nozzle operator, truck driver, flagman and three laborers. Such a crew has pumped as much as 28 cu. yd. of slurry in a 10-hr. day. The slurry used was a mixture of topsoil, cement and water in the proportions of four sacks of cement per cubic yard of soil with 50 to 55% water. Holes were drilled with a pneumatic hammer using a 1½-in. bit although 1¾ or 2-in. bits were also used to permit use of a larger nozzle opening where selected soil was not available. The cost for drilling these holes was estimated at 7 to 10 cents each.

In several states, liquid asphalt was used under the pavement in place of a slurry to reduce pumping action of slabs. Good results have been reported with a low penetration asphalt having a high melting point. The contract price for this type of work in one state was reported to be 12½ cents per gallon of asphalt pumped and 23 cents per hole for drilling.

Shoulder Costs

The availability of unit costs on shoulder maintenance is also limited.

The highway departments were questioned by field maintenance engineers of the Public Roads Administration on the maintenance of shoulders, especially turf. While an average cost per mile of shoulder maintenance was frequently available, it was not identified with a specific type of shoulder or broken down for the various operations so as to be used in comparisons between states.

The following is the cost per mile in one eastern state for maintaining 8-ft. turf shoulders:

	Cost per mile
Mowing (48 swath-miles at $0.41. This includes two round trips per mowing performed twice a month during the growing season or for approximately six months)	$19.68
Machining or rolling high places to keep good drainage (each year)	50.00
Patching and reseeding (each year)	25.00
Total annual cost per mile	$94.68

(*Continued on page* 126)

Expansion Joint Practice

Nation-wide summary as compiled by a manufacturer

EXISTING state highway department specifications reflect a continued use of expansion joints but vary widely as to type and spacing, according to a survey report issued by Keystone Asphalt Products Co. of Chicago. Five states, in this summary, report the elimination of expansion joints but 41 still hold that expansion joints are necessary.

Expansion Joints. According to the accompanying table compiled early in 1946 asphalt joints are used or permitted in 12 states, fibre joints in 27, sponge rubber in 11, cork in 21 and other types in 20 states.

Spacing of expansion joints when used varies from 40 to 600 ft. with an average of 150 ft.

Joint thickness specifications also vary greatly, it is to be noticed, ranging from ¼ in. to 1 in.

Dummy Joints. The survey shows a definite trend toward the closer spacing of dummy joints advocated by authorities. Dummy joint spacing runs from 12½ ft. to 100 ft., the latter being an exception (Michigan). A variation of opinion occurred on thickness of the joint and installation depth. The majority of states uses a joint 2 to 2½ in. deep or set one-third the thickness of the slab. Thickness runs predominantly to ¼ and ⅜ in. with a trend toward thinner dimension. Openings of ¼ or ½ in. are too wide for dummy joints and this practice has only been followed by reason of the fact that standard premoulded asphalt joint has not heretofore been manufactured in thicknesses less than ¼ in. Some engineers prefer edging of the dummy joint.

Center Strip. Although a good many engineering authorities are said to have recommended tongue-and-groove construction for center strip efficiency, only half of the states are using this type joint, according to the Keystone survey. Seventeen states use T & G, 20 use dummy joints, and seven use butt joints. Some states permit optional use of either T & G or dummy joint; naturally the contractor selects the lowest cost material, usually the dummy. Some contractors use a wood wedge on lane-at-a-time construction to create the T & G joint but the concrete face against concrete face defeats the entire purpose; being without a bearing surface, spalling is bound to result.

Joint Sealing Compound. Although rubber-asphalt joint sealing compound is only a few years old its extensive use in the war years led to a Federal Specification, SSF-336. Ten states already use such a compound while 32 use the regular asphalt joint sealing compound. Some states have used the compound for an entire poured dummy joint, which the manufacturer hesitates to recommend.

(*See following pages*)

Highway Program Lags

Recent figures released by the PRA underscore a marked slowness in getting the postwar highway program under way, according to an ARBA bulletin. As of May 31 only 68 contracts for improvements to the primary system had been placed under construction involving a cost of $12,581,000. As of the same date 1,334 miles of secondary road improvements were under construction involving a cost of $33,963,000. Total work (regular federal-aid and secondary) under construction as of May 31 amounted to approximately 46.5 million dollars.

By way of comparison it may be noted that as of May 31, 1941, the last normal prewar year, total highway work under construction amounted to $295,000,000. This total involved work on the regular federal-aid system, secondary system and grade-crossing elimination.

On the brighter side of the ledger the PRA reports that during the five-month period from Jan. 1 to May 31, 1946, a total of 1,230 contracts were let for approximately $185,900,000 worth of improvements on the federal-aid system. During the month of May, state highway departments let 425 contracts for federal aid projects at a cost of $58,166,360. This compares with 392 contracts let in April at a cost of $55,932,506. With regard to secondary improvements, a total of 2,851 projects have been programmed as of May 31 involving an estimated cost of $217,109,681.

During the period Jan. 1 to May 31 the state highway departments rejected 329 bids for federal-aid road work without action by the PRA. Fifty-six bids were rejected by the PRA on the grounds of "high bidding."

In reviewing these figures it is well to keep in mind that federal-aid funds alone, now available for obligation, amount to approximately a billion dollars. It is thus apparent that the program to date is far from keeping pace with the availability of funds. The reasons for the delay in getting the program under way are numerous and generally well known. However, recent trends have been encouraging and it is hoped that the program will rapidly gain momentum in the coming months.

•

Pan American Road Opens 1,498 Miles

It is now possible to travel over the Pan American Highway in Mexico from the United States border at Laredo, Texas, to San Cristobal Las Casas in the state of Chiapas, a total distance of 1,498 miles. When completed, this "main street of the Americas" in Central America will consist of 3,250 miles of all-weather road from Laredo to the Panama Canal. The highway is paved from Laredo to Mexico City, a distance of 762 miles, and is hard-surfaced 344 miles further to Oaxaca. The improved road now extends about 50 miles beyond Oaxaca.

•

Mahaffey Heads Virginia Road Body

S. J. Mahaffey, formerly Henrico County Virginia Manager and recently City Manager of Durham, North Carolina, has succeeded Mr. A. J. Rayner as executive secretary of the Virginia Road Builders' Association. Mr. Rayner resigned recently.

Survey of Concrete

as published by Keystone

	TRANSVERSE EXPANSION JOINTS									DUMMY			
	Asphalt	Fibre	Sponge Rubber	Cork	Others	Spacing, Feet	Thickness, Joint	Inches Below Slab Surfaces	Standard Thickness of Slab	Mastic Board	Poured	Premoulded Asphalt	Flexplane Machine
ALABAMA	×						1"		8"-6"-8"		×	×	
ARIZONA		×			Wood	600'	¾"	¾"	9"-7"-9"		×		
ARKANSAS													
CALIFORNIA				No Exp. Joints Now Installed					8"		×		
COLORADO	×					90'	¾"	½"	9"-6½"-9"		×	×	
CONNECTICUT	×					97'-4"	½"	1-¼"	8"		×		
DELAWARE				×		120'	¾"	½"	8"				
DIST. OF COL.		×		×		30'	½"	2"	8"				
FLORIDA	×		×	×	Board Cotton-seed Hull Mix	60'	¾"	1"	7" & 9"-7"-9"		×		
GEORGIA	×	×				90' to 300'	¾"	⅝"	7" to 9" Var.		×	×	×
IDAHO		×				90' to 120'	¾"	Flush	9"-7"-9"		×	×	
ILLINOIS	×	×			Redwood & Cypress	100'	¾"	½"	8" to 10"		Not Used		
INDIANA	×	×	×	×	Cork Rubber	Used Only at Bridges & Intersections					×	×	
IOWA	×					120'	1"	½"	10"-8"-10"				×
KANSAS													
KENTUCKY		×				600'	1"	½"	9"-7"-9"		×		
LOUISIANA		×			Wood	120'	¾"	¾"	9"-6"-9"		×		
MAINE		×		×	Cork Rubber	80'	½"	½"	9"-7"-9"				
MARYLAND			×	×	Cork Rubber	120'	¾"	½"	9"-10" & 9"-7"-9"		×		
MASSACHUSETTS		×		×		120'	¾"	1"	8"				
MICHIGAN					Wood	400'	1"	¾"	7" to 10"		×		
MINNESOTA		×	×	×		Used Only at Bridgeheads & Railroad Crossing				×	×	×	×
MISSISSIPPI		×					¾"	½"	9"-6"-9"		Not Used		
MISSOURI					Pre-moulded Filter	40'	3/16"	¼" to ½"	8"		×	×	
MONTANA						No Specifications					No Specifications		
NEBRASKA		×				500'	1"	1"	8"			×	
NEVADA		×		×		60'	¾"	½"	9"-7"-9"		×		
NEW HAMPSHIRE			×	×	Cork Rubber	50'	¾"	⅝"	7"		Not Used		
NEW JERSEY					Wood	56'-4"	¾"	1"	9" & 10"				
NEW MEXICO	×	×		×		60'	¾"	½"	9"-6"-9"		×		
NEW YORK		×			Redwood or Cedar	100'	¾"	½"	7" to 10"				
NORTH CAROLINA		×	×	×	Cot's'd Hull & Board	120'	¾"	½"	7" to 10"		×		
NORTH DAKOTA		×	×	×			¾"	¼"	8"		×		
OHIO		×			Wood	300'	1"	⅛"	9" & 10"	×	×	×	×
OKLAHOMA		×		×	Redwood	120'	¾"		9"-6"-9" & 9"-7"-9"		×	×	×
OREGON		×		Bridge Ends Only			¾"	⅜"	8"			×	
PENNSYLVANIA	×	×		×	Cork & Rubber & Wood	77'	¾" to 1"	1"	8" to 10"				
RHODE ISLAND				×		73'-6"	¾"	½"	8"		×		
SOUTH CAROLINA					Poured	100'	1"	Flush	6½" to 8"		×		
SOUTH DAKOTA	×					90'	1"	½"	9"-6"-9"		×		
TENNESSEE		×				120'	¾"	½"	8" to 10"		×		
TEXAS					Redwood & Cypress	90' to 120'	¾" to 1"	1"	9"-7"-9"		×		
UTAH		×	×	×		90'	1"	¼"	8"		×		
VERMONT	×				Wood	61'-2"	½"	½"	7"				
VIRGINIA			×	×		90'	¾"	½"	9"-7"-9"		×	×	
WASHINGTON					Red Cedar	300'	25/32"	¾" to ⅞"	8" & 9"	×			
WEST VIRGINIA		×	×	×		120'	¾"	¼"	8"		×		
WISCONSIN		×		×		Bridge Approaches Only			7" to 9"		×		
WYOMING		×	×	×		50' to 60'	¾"	¾"	6"		None Used		

Pavement Jointing Details

Asphalt Products Co., Chicago

CONTRACTION JOINTS				CENTERSTRIP					JOINT-SEALING COMPOUND		
Others	Spacing, Feet	Width or Thickness of Joints	Depth of Joints	T & G (Mastic Board)	T & G (Steel)	Dummy Type	Butt Type	Other	Depth in Inches	Poured Asphalt & State Spec. Nos.	Rubber Asphalt Such as Spec. SSF-336
		⅜"	⅓ Thk.			×			¾"	Ala ×	
	12½"	3/16"	⅓ Thk.		×		×		¾"		×
	15	¼"	1¼"					T & G Spec.		Calif. SC-6	
	30	½"	2½"			×			½"		
	24	¼"	1½"					"V" Shape Key	1½"	×	
	30	¼"	Thk. ⅓"		×				½"	R-196-×	
Metal					×						×
	20	⅝"	2"		×	×			¾"	AASHO× M-18-42	
	20	¼"	¼ Thk.		×	×			⅝"	×	
	15	½"	2"			×				×	Contemplated
		Not Used			×				½"	PAF 4	
	40	¼"	Thk. ⅓		×	×		Flexplane	1" to 1½"		×
	30	1/16"	3"			×			½"	AASHO× M-20-22	
	30	⅜"	2½"		×				½"	AASHO× 7-7-4	
	20	¼"	Thk. ⅓"			×				3-4-13 ×	
	20	2"						Tongue & Gr've	½"	×	
Deformed Plate	15 to 40	¼"	2½"				None		½"	Md.-K ×	
Spec.	30	¼"	2"				×		1"		×
	100	½"	2"			×			¾" to 1"		×
	15	⅛" to ⅜"	Thk. 30%			×			¼" to ½"	×	×
		Not Used			×	×			½"	×	
Metal Spec.	50	⅛" to ¼"	¼" to Full Thk.		×				¼" to ½"	38-19A-1-E ×	
		No Specifications				No Specifications				No Specifications	
	20	⅜" to 2½"	2½"			×		Deformed Metal	¼" to 1"	AF × Art-112	
	30	¼"	2½"					T & G	½"	91 ×	
		Not Used					×			25-29 ×	
								T & G Spec.	⅞" & 1"	B-M-2 ×	
	30	⅜" & 7/16"	2½"		×	×			½"	AASHO × M-18-A	
	30	¼"	¼-Thk. or 2"		×	×	×		¼" to ½"	AP-2 ×	
	15	¼"	⅓ Thk.			×				ASHO M-18-42-A	
	40	⅛" & ⅜"	3"			×		T & G			
	20	¼" & ⅛"	⅓ Thk.	×	×				1½"		×
	15	¼"	2"					T & G X	¼"	Spec.	
								Spec.	¼"		J-1 ×
	20	¼"	⅓ Thk.				×		½"		×
	33⅓"	⅛"	½ Thk.					Poured			
	30	⅜"	2¼"			×			½"	×	
	20 to 30	⅜"	½ Thk.		×				½"	BAC 3 ×	
	15 to 20	½"	2" to 3"		×				½" to 1"	OA-30 ×	
	15	⅜"	2"			×			¼"	AASHO M-18 ×	
								T & G	½"	AASHO M-20 ×	
	30	¼"	2½"		×				½"	×	
	15	⅛"	2"			×			¾" to 1"		×
	20 to 30	¼"	2½"		×	×	×		¼" to ½"		
	15	¼"	⅓ Thk.					Poured		JFA ×	
		None Used					×		¾	×	

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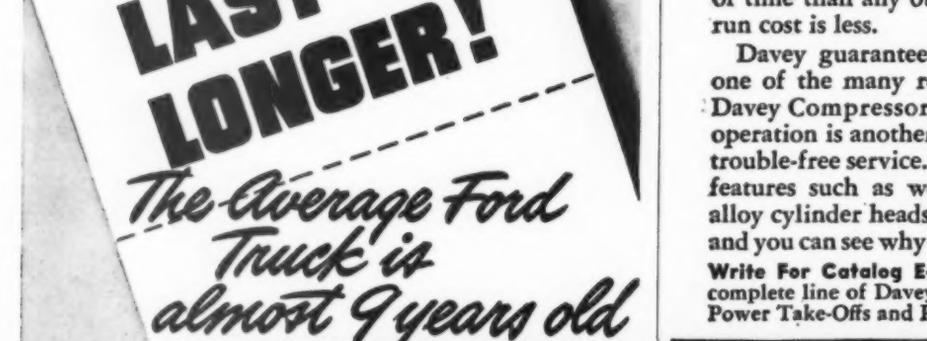

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Hard-Facing GRADER BLADES

The widespread interest of maintenance foremen prompts these helpful suggestions by W. Wesley Mills, Director of Research, MIR-O-COL Alloy Company

HARD-FACING applied to the face of a road grader blade, scarifier tooth or other earth cutting implement, the equipment not only lasts longer, but the hard-facing gives a self-sharpening edge. Because the portion of the blade under the hard-facing tends to wear away much faster than the hard-faced portion, the blade automatically stays sharp until all the beveled portion has been worn away. This eliminates removal of the blade or part for sharpening.

Hard-facing is applied about 3/16-in. thick in a band about 1 in. to 3 in. wide on the face of a grader blade's edge, as in Illustration A.

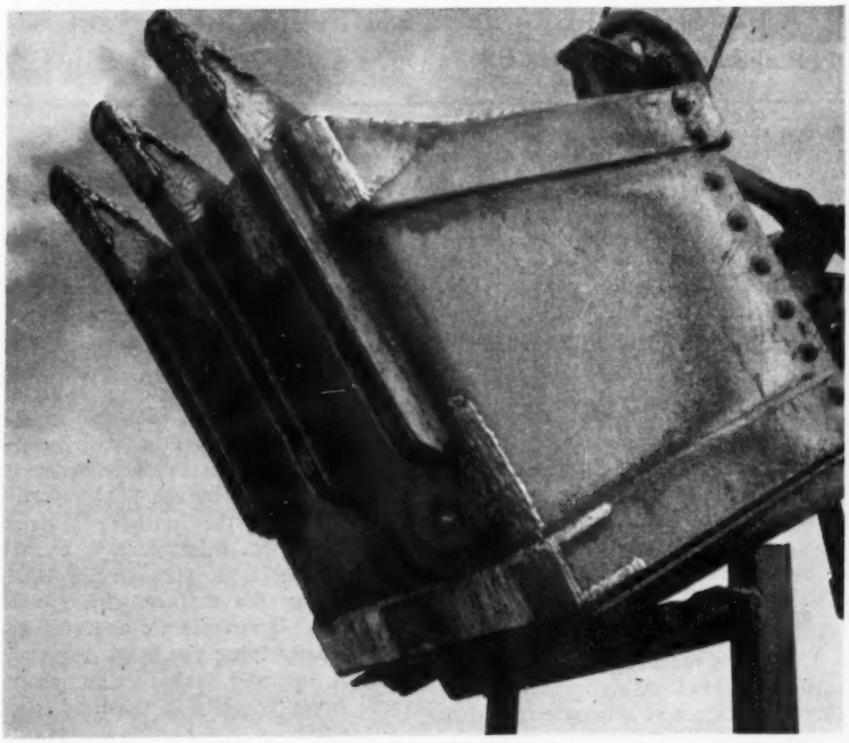
Preparation: Clean the portion of the blade to be hard-faced. The best method is by grinding. Clean a strip from one to three inches wide along the entire length of the blade's cutting edge. To assure an unbreakable hard-facing bond with a minimum of porosity, the blade must be free from dirt and mill scale. (Illustration B.)

Warpage Prevention: There are three ways to prevent warpage of the blade when it is heated.

1. Bolt two blades together.
2. Build a backing plate to which the blade can be bolted.
3. Clamp the blade firmly to a steel welding bench.

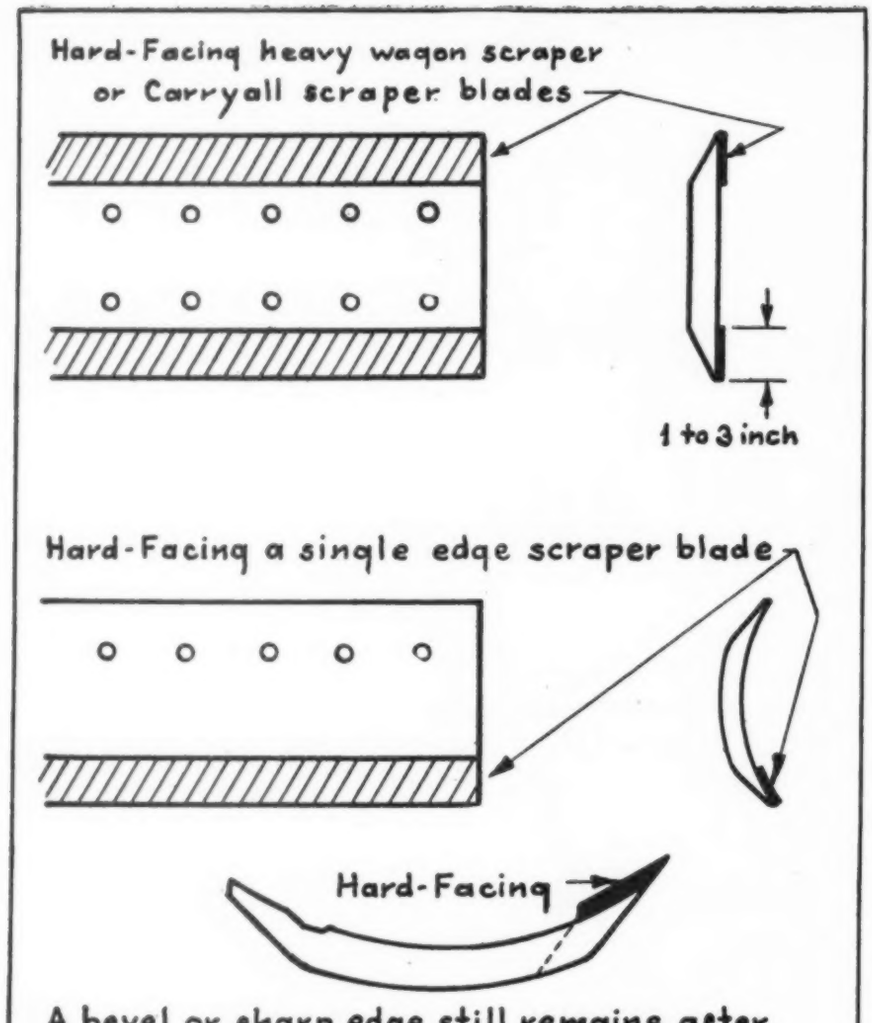
The precaution of backing-up the blade, using care in pre-heating, and applying the hard-facing by skip welding will reduce warpage danger to a minimum. (Illustration C.)

Pre-Heating Necessary: Pre-heat the blade in an oven if possible, and arrange by some method to maintain a constant heat during the entire hard-



Shovel Dippers and Teeth, Too

★ Here is an example of a nicely hard-faced ½-yd. shovel dipper, snapped by the R & S editor on a western job. Note hard-facing at corners, along the bottom edge and over the teeth


Hard-Facing heavy wagon scraper
or Carryall scraper blades
1 to 3 inch
Hard-Facing a single edge scraper blade
Hard-Facing
A bevel or sharp edge still remains after
hardfaced portion has worn away - see dotted line

★ Illustration A. Diagram showing method of applying hard-facing to single and double-edge grader blades. Always deposit hard-facing on the wearing face of the blade

facing application. One way is to have a long gas pipe with a row of jet outlets. Apply the heat on the "under" side, the full length of the blade. You can pre-heat with a blow torch or acetylene torch if no other method is available.

Pre-heating is the best preventive measure against upsetting. If the blade is pre-heated, the degree of expansion will be much less when the intense heat of the torch or arc is applied, and the structural stresses will be minimized. (Illustration D.)

Electric Welding Procedure

1. Set the machine high enough to turn the rod red. A high machine setting permits use of a longer arc, with wider dispersal of heat. This will allow shallow penetration, and yet a strong bond is possible with a minimum of hard-facing dilution.

2. Use a circular motion in applying beads an inch or more wide. Hold the rod at a 45-degree angle and strike an arc in what will be the center of the first circle. Follow a spiral course, as shown in the diagram. (Illustration F.)

3. Use skip welding, first applying a 6 to 9-in. strip at each end of the blade, then a 6 to 9-in. strip in the center. Follow this procedure until the full length of the blade is surfaced. Apply the hard-facing from 3/16 to ¼-in. thick, *always* on the face of the blade. (Illustration E.)

4. Clean the surface with a wire brush to eliminate scale and slag before finally tying the beads together. If not removed such foreign matter will cause porosity in the hard-faced deposit.

Acetylene Welding Procedure

1. Clean and pre-heat the blade, as outlined for the electric process, then start at one end of the blade and apply in a continuous bead the full length of the blade.

2. Use a tip that will give a soft, bulbous flame, and hold the torch so that the brush of the flame strikes the work at a 45-degree angle. To obtain a soft flame, set both oxygen and acetylene gages at about 10 lb. pressure. (Illustration G.)

Remember that the surface oxides in the parent metal must be reduced before depositing the hard-facing. If too much acetylene is used, carbon will be deposited on the surface. If insufficient acetylene is used, the oxides will not be reduced. The melting of the parent metal *must* be confined to a very shallow depth. A harsh flame would penetrate too deeply and result in excess dilution of the hard-facing. Very little penetration is necessary to assure a solid bond. (Illustration G.)

Normalizing or Stress Relief

After the hard-facing application is completed, whether using electric or acetylene method, place the blade in an oven and raise the temperature slowly to 800°-1000° F. Then turn off the heat and allow the blade to cool slowly in the quiet oven air.

If no oven is available, the blade can be heated evenly with a torch, then covered with sand or lime and allowed to cool slowly.

Normalizing the blade will reduce the possibility of its breaking when in use.

Effect of Heat on Metals

Heat is a form of energy, and as such can be either a destructive or constructive force. The tempering of steel is an example of the beneficial effect of heat correctly applied to metal. In welding, a condition known as "upsetting" which often occurs is an example of the harm that can be caused by improper application of heat. Because the term "upsetting" is used frequently, it is well for the reader to know just what is meant by this expression.

Upsetting or Expansion

When metal is heated it expands. This is not only a change in length but actually is an increase in volume. Thus, when the surface of a large block of steel is subjected to a source of intense heat, such as the oxy-acetylene flame or the electric arc, the volume of the heated mass increases.

Since the transmission of heat from the localized surface to all portions of the block of metal is not uniform, the result is that greater expansion takes place at the point the flame or

arc touches the surface. Because of the rigidity of the metal, the expansion is first evident as an internal stress, tending to bend the metal in the direction that will give maximum relief to the stress. If the metal is thin, the stress will cause a warpage which may become a permanent deformation of the block. If the block is a heavy section, the internal stress will be relieved by pushing the surface upward at the point of greatest heat. It is this "push-up" that is called upsetting.

Contraction or Shrinkage

When a heated block cools, contraction occurs and the change in volume becomes "shrinkage." If the shape of the block has been altered by an upsetting action on the surface, internal stresses will develop.

Warpage will develop if the overheated section is thin. But if the upset section is heavy enough, its rigidity will prevent most of this warpage, with the result that when shrinkage occurs, the surface will "stretch" or check to equal the expansion and upset.

How to Minimize Setting

Since upsetting is highly undesirable, every precaution possible should be taken to prevent it. The best preventive measure, whenever possible, is preheating, applying the heat to the entire artcile even though only a small portion of it is to be hard-faced. Preheating partially expands the whole block; then, when the torch or arc is applied to the surface, the degree of expansion will be much less than if the block were cold, and stresses developed by the localized heating will be minimized.

Some welders mistakenly believe that it is the metal deposited (whether in a straight welding or hard-facing application) that causes distortion, warpage, shrink checking, and cracking. This is not true. All of these conditions are caused only by upsetting from the heat of the torch or arc.

Heat Treatment After Hard-Facing

It is necessary in some cases to heat treat a piece of steel equipment after it has been hard-faced. This will slightly increase its hardness, but the temperature should never be raised higher than 1800° F. The heat treatment should be the same as recommended for the parent metal. It will not cause the hard-facing deposit to check nor to come loose from the bond.

"How" of Processes Used

Hard-facing can be applied by either the oxy-acetylene or the electric arc welding method, although the technique of application is not the same as in ordinary steel welding. This difference in technique must be borne in mind constantly in order to obtain successful hard-facing deposits.

Comparison of Methods—Electric Arc vs. Oxy-acetylene

Electric arc application is advantageous for large areas of application over irregularly worn surfaces, or where a fine finish or precision dimensioning is not necessary. The electrode is flux coated instead of bare. Function of the coating is to (a) stabilize the arc; (b) control the melting rate of the hard-facing metal; (c) protect the molten metal from contamination by atmospheric elements; and (d) in some cases to add alloys to the deposit.

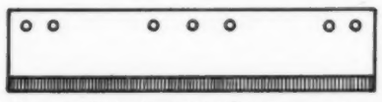
While not as flexible as the gas welding process, the resultant deposits are often equal in quality, and the speed of deposition is greatly accelerated over the acetylene method. It should be remembered, however, that the arc method tends to result in a deposit somewhat diluted with iron of the base metal, softening the deposit and reducing its resistance to abrasive wear. Oxy-acetylene application is preferred where a thin overlay of metal is required. It is especially suitable for precision motor parts because of the closer control over the molten material. A transparent flux coating helps to remove oxide and scale from the base metal when hard-facing in more than one layer.

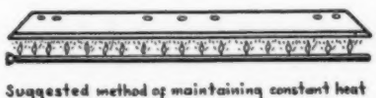
The carbon arc process is usable on metals which can be hard-faced by either electric or acetylene method.

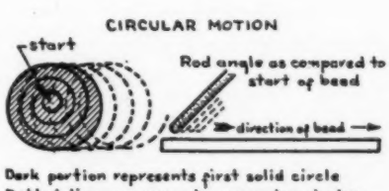
How to Judge a Good Hard-Facing

The true test of a good hard-facing job lies in the extra service life it gives to the part treated. On a properly hard-faced part, the metal resists abrasion at red heat and withstands impact without shattering. To test for abrasion resistance, lay a bead or pad on a piece of low-carbon steel about ¼-in. thick. Bring it to a red heat, then test it on a grinding wheel. If it mushes off or wears away too rapidly, it does not have sufficient "red hardness" to give it resistance to high frictional heat.

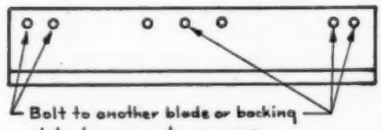
For impact test, after the hard-facing pad becomes cold, lay the piece on a solid surface and pound it with a heavy sledge. The hard-facing should not flake off nor disintegrate even when mashed nearly through the base metal. Checks will appear, but if it flakes or mushes, it has failed to qualify as an impact-resistant hard-facing deposit.


Grind area to be hard faced-1 to 3" band across face
B


Suggested method of maintaining constant heat on blade during hard facing operation
D



Dark portion represents first solid circle
Dotted lines represent successive circles
F



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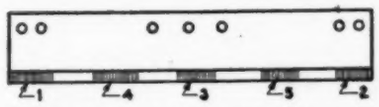
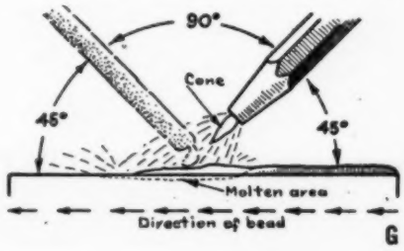


Apply hard facing by "skip welding" when using the electric process.
E



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AGC Pledges Efforts Against Unjustifiable Cost Increases

The officers, Board of Directors and the Advisory Board of The Associated General Contractors of America at its meeting July 1-2 in Denver, Colo., unanimously agreed that the elimination of the government price and wage controls "is definitely anti-inflationary," and representing the association's more than 3,800 active construction organizations performing every type of construction in all 48 states and every U. S. Territory, pledged its full efforts to the prevention of unjustifi-

able increases in construction costs.

The senior executives attending from all parts of the nation resolved that the 97 Branches and Chapters and the members of the association be advised to accede to the President's request to maintain a condition of status quo pending further Congressional action on the Price Control Act and the Stabilization Act, "and particularly that they enter into no ill considered agreements or purchases until a policy is established by law or free competition is established; and thereby demonstrate that free competitive industry is self-regulating and will curtail inflationary prices better than unenforceable attempts at a controlled economy."

Agreements reached unanimously at the meeting follow:

First: (1) The elimination of the government price and wage controls is definitely anti-inflationary. It will do much to level off prices and increase production and eliminate black markets in lumber, brick and other construction materials by permitting manufacturers to adjust prices commensurate with fair wages and other costs.

(2) It places private enterprise of all classifications and the construction industry in particular in a position where free competition and initiative will level and control prices fairly and equitably after a period of readjustment.

(3) The elimination of government price and wage controls is strongly welcomed and concurred in.

Socond: The Associated General Contractors of America urges further elimination of such other regulatory acts and directives enacted and issued during the war years which have suppressed and interfered with the return to free American development.

Third: This association, with more than 3,800 active construction organizations, represented here by senior executives from all parts of the nation, pledges its full efforts to the prevention of unjustifiable increases in construction costs.

A second resolution governing the period following the expiration of the Price Control and Stailization Acts follows:

Whereas, the President of the United States has vetoed the measure proposing to extend the Price Control Act and the Stabilization Act from June 30, 1946 to June 30, 1947, and has specifically asked business and labor to maintain a condition of status quo, pending any further Congressional action on this subject; and

Whereas, industry and labor are now dependent on their own sound judgment and self restraint;

NOW, THEREFORE BE IT RESOLVED that the Board recommend to the Branches, Chapters and Members that they accede to the President's request and particularly that they enter into no ill considered agreements or purchases until a policy is established by law or free competition is reestablished; and thereby demonstrate that free competitive industry is self-regulating and will curtail inflationary prices better than unenforceable attempts at a controlled economy.

TRANSITS and LEVELS

HEADQUARTERS for REPAIRS – any make

We will buy or trade in old Transits Levels, Alidades, etc. Send instruments for valuation.

Write for new Catalogue RS-97 of Engineering Instruments, Engineering Field Equipment and Drafting Room Supplies.

WARREN-KNIGHT CO.
Mfrs. of Sterling Transits & Levels
136 N. 12th St., Philadelphia 7, Pa.

OTC
MAINTENANCE
TOOLS
OTC PUSH-PULLER removing rear wheel spindle on the Diesel No. 12 Motor Grader by pushing it through bearing. Savings in costly parts, labor and "lay-up" time on jobs soon pay for OTC TOOLS.
Save
CRITICAL PARTS from DAMAGE
Why let your mechanics take chances with "hammer-and-hope" or "poke-and-pry" methods of removing and replacing bearings, gears, sleeves, sheaves, wheels, shafts and other close-fitting parts? The OTC PULLING SYSTEM provides the proper tools to do these jobs SAFELY, easily and quickly —in the shop or on the job. Approved by Hyatt, M-R-C, New Departure, SKF and Timken for use on their bearings.
No. PE-15 Maintenance Set for track type tractors, Diesel motors, road maintainers, power shovels, drag lines, etc. 2 GRIPOMATIC PULLERS (20 and 9-ton capacities), PUSH-PULLER with extra 22¼" and 16½" legs, Pulling Attachments, Heavy Duty BOX WRENCHES and 24" Tubular Handle.
Write for OTC Maintenance Bulletin showing time-saving OTC uses.
OWATONNA TOOL CO.
319 CEDAR ST., OWATONNA, MINN.

Postwar Parade

of New Construction Equipment and Materials

New Marion 3½-4 C. Y. Heavy Duty Machine

1. Marion Power Shovel Company of Marion, Ohio, announces a new 3½-4 cu. yd. machine—The Type 111-M—for heavy duty service in mining, quarrying, stripping and general construction. The 111-M is a diesel machine which can be readily shipped without major dismantling and which is also quickly convertible to dragline or

New Marion Type 111-M

clamshell service. It has a balance of power, weight, and dipper capacity to meet the requirements of heavy-duty service in pit or quarry work. It is of all welded construction with a balance in design providing for low center of gravity, making the machine stable under all digging conditions. Particular care has been given to speed, power, ease of control and maneuverability. Variable crawler widths and lengths are offered. The upper machinery deck indicates simplicity and accessibility. There are only two main shafts, mounted in anti-friction bearings, on the upper deck, providing direct line of power application, thereby simplifying maintenance and assuring added long life for the machine. The Type 111-M is quickly convertible to dragline, clamshell, or crane service. Anti-friction bearings for all high speed shafts and unit construction assure long life and low maintenance expense.

Control lever pressure is held to about 12 lb. max. The fully-compensating type valves give the operator the constant "feel" of the load and enable him to apply or withdraw power gradually or quickly. For crane or pile driver service, the Type 111-M is equipped with a heavy duty box section type boom with steel angles and pipe-section bracing. The boom point section is of goose-neck design which permits minimum radius operation.

An independent live boom hoist may be supplied with the Type 111-M for crane service. It is completely independent of all other motions.

11 Cubic Foot Mixer

2. Outstanding features of the new Kwik-Mix 11-S Dandie concrete mixer are completely illustrated and described in a new catalog just published by the Kwik-Mix Company, Port Washington, Wis. The new catalog contains 38 photographs and diagrams of the Kwik-Mix 11 cubic foot mixer.

Complete dimensions and condensed specifications are given for the 2-wheel and discharge models and for the 4-wheel 11-S Dandies which are offered either as end or side discharge mixers.

In the new catalog, particular emphasis is placed on the thorough remixing action of the Kwik-Mix 11-S Dandie and on its heavy duty construction. High strength steel is utilized at every point of strain. Because of its tilted flow-line discharge chute, the Kwik-Mix 11-S Dandie is completely discharged in two revolutions of the drum or in 7 seconds. Charging time is cut, it is claimed, and shaking strains are reduced with a new selective skip shaker, which shakes only after the skip is partly empty.

Mail Inserted Card

for data on equipment described on these pages

New Fire Engine

3. Details of a new 750-gal. triple combination FWD fire fighter were released this month by The Four Wheel Drive Auto Company. The new Model F75T, developed as a standard FWD fire fighting unit, is the outgrowth of over 30 years' experience in custom-built fire truck manufacture.

FWD Model F75T 750 gal. triple combination fire fighter

The F75T employs the FWD four-wheel-drive principle with a center differential which imparts a balanced

tractive effort to all wheels. This gives the driver better steering control as wheel slippage and the tendency to skid is reduced. The powered front wheels pull in the direction steered, enabling the vehicle to take curves safely at higher speeds, the manufacturer states.

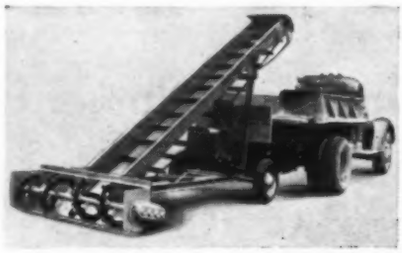
When difficult operating conditions are encountered and traction is lost, a manually controlled lock eliminates the center differential action and provides positive drive to both front and rear axles. With four-wheel-drive, the fire fighter is able to travel faster and safer on ice and can plow its way to the fire through mud and snow. In rural fire fighting, it can be driven across country, over plowed fields, through swamps, directly to a creek or lake or other water source.

Powered with a six-cylinder 190 B.H.P. FWD engine, the Model F75T has a piston displacement of 525 cubic inches and develops 410 foot pounds of torque. The wheelbase is 160 inches.

Equipped with an FWD centrifugal 750 GPM two stage series-parallel pump, the new fire engine features large volume-low pressure and reduced volume-high pressure performance controlled by means of a transfer valve.

New Snow Loading Machine

4. A new snow loading machine, the Sno-Loder, has been announced by Pneu-Hydro Road Machinery Co., Cadillac, Mich. The machine is a rubber-tired mobile unit having a 6-ft. wide scoop with tooth-edged formed-helix ice cutter and self-loading conveyor powered by a 15-hp engine. It is towed to and from jobs at unhampered truck speed. For snow



The Sno-Loder

loading, the scoop is dropped to the windrow and the unit is propelled evenly and steadily through backing action of the truck. Trucks are loaded evenly and full by means of a load distributor. All controls are conveniently located on the truck driver's side and are handled easily by one man who can quickly communicate with the driver. Three levers control the entire machine action: (1) the clutch (engine) lever, (2) the load-control lever (shifting load from front to rear as the truck fills), and (3) the hand brake lever for positive control on inclines.

New Check Valve for Air Hose

5. A safety check that is claimed to eliminate the danger of wildly whipping compressed air hoses by shutting off air immediately in the event of excessive flow of air caused by accidental disconnecting or rupture in the air line, has been placed on the market by E. D. Bullard Co., San Francisco, Calif. The possibility of damage to compressors or manifolds through travel-back of whipping action in hoses is also obviated. Many other applications for this safety check are now being tested. There are only two main parts in the Numatic safety check. These are the housing and a steel ball. The valve housing proper has female threads in both ends for attachment to compressor and air line. For convenience of installation the ends are hexagonal in shape. The steel ball rests between

CITY STREETS REQUIRE PAVEMENTS TO BE IN SOLID CONTACT WITH RAILS.

Servicised

PREMOLDED
RAIL FILLER
FOR TRACK
INSULATION

MUFFLES NOISE BY DIMINISHING VIBRATIONS!

← Holds Rails Solid, But in Resilient Contact With Pavement.

Servicised—Bituminous Resilient Rail Filler Cuts Down Maintenance Costs for Both City and Railway Company by Eliminating Expansion & Contraction Damages.

NATURE OF OUR RAIL FILLER

Through many long years of successful service our resilient Rail Filler has more than proved its inherent value to both city and Ry. company. Waterproofing spaces between rails and pavement have prevented infiltration, freezing, cracking and costly deterioration; also eliminating problems of vibration, noise, contraction, expansion and costly re-alignments. Street Railway Systems are possibly the largest users of Servicised Rail Filler, but it is also frequently used where interstate or interurban railroads run in contact with city pavements for distances of a few blocks to several miles.

SERVICISED PRODUCTS CORP.
6051 WEST 65TH STREET CHICAGO 38, ILL.

the hexagonal ends in a sump at the compressor end of the valve. The safety check is manufactured for working pressures up to 250 pounds and comes in standard ½-in. and ¾-in. sizes.

Photo-Electric Lighting Control

6. The Photo-Electric Control for Multiple Street Lighting is a recent addition to the line of Fisher-Pierce Company, maker of electronic controlling devices. Available at this company's address, 82 Ceylon St., Boston 21, Mass., a catalog has been published analyzing the economics and technical advantage of such street lighting controls, and highlighting some of the mechanical and electrical details and operating principles. It

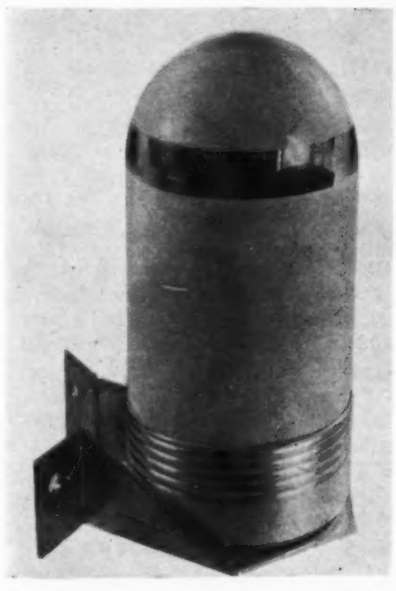


Photo-Electric Light Control

is said that the control offers advantages from the standpoint of flexibility of operation; quality of lighting service; and operating cost. The light, under this control, is turned on as soon as the north sky light is reduced to a certain value. A delay device protects against reacting to lightning, and there is an automatic cut-out from the power line in event of surge-induced or shortage line failure. The unit is suitable for controlling up to 50 watts of incandescent lamp load directly. Life for various tube types ranges from 10,000 to 25,000 service hours.

Dwarf Orange Peel Bucket

7. Designed for operation inside a 12-in. drain pipe and for digging wells, catch basins and small drainage

FOR CONCRETE VIBRATION ON EVERY TYPE OF JOB IT'S

JACKSON 2 to 1

JACKSON FLEXIBLE SHAFT
Model FS-7A

A lightweight, easy-to-handle electric vibrator of wide adaptability. Will handle any of our standard vibrator heads up to 2⅜" x 18⅜" with shafts up to 21' long. Universal motor, 115 volt AC or DC. Frequency 7,000 to 10,000 V.P.M. Available with shaft lengths of 24", 36", 7', 14' and 21'. Skid type handle.

You state your concrete vibratory problem, and we'll supply the answer and lay you 2 to 1 that the JACKSON equipment we recommend will not only do the best possible job in the shortest possible time, but will also be the most dependable, trouble-free vibratory equipment you have ever owned. The line covers the entire field of concrete construction.

General Construction · Light Construction · Mass Concrete · Hard-to-get-at Places · Form Vibrating · Floors, Streets and Highways · Pipe Manufacturing · Movement of Materials · Vibratory Tables, etc.

Write for complete information and recommendations or the name of the nearest JACKSON distributor where this equipment may be seen.

JACKSON HYDRAULIC
Model HS-A1

A husky, dependable concrete vibrator for general use. Oil powered, gas engine hydraulic pump drive. 4000 to 7000 V.P.M. Head — 2¾" x 21". Quickly fitted with head for wet or dry rubbing, drilling, etc. Balanced for easy lift. Drop handles for easy hose disposal.

JACKSON FLEXIBLE SHAFT
Model FS-6A

A very dependable independent unit, gas engine powered. Up to 7500 V.P.M. 3 heads for thick and thin sections. Flexible shafting in 7 ft. to 14 ft. lengths up to 28 ft. Automatic clutch. Swivel base. Wheel barrow optional. Available with grinding and other attachments.

ELECTRIC TAMPER & EQUIPMENT CO.
LUDINGTON MICHIGAN

ditches, the improved Hayward Dwarf Orange Peel Bucket makes possible significant economies in removing all kinds of materials such as broken stone, boulders, old timber, metals and other substances found in "filled-in" ground. Full details are given in a new Hayward Bulletin, No. 804, that has just been published by the manufacturers, The Hayward Company, 50 Church Street, New York 7, N. Y. This bulletin will prove helpful to contractors, sand and gravel operators, and others who are seeking an effective means of removing materials from the inside of pipes or cylinders from depths varying from surface level to 75 ft. or more. It contains interesting illustrations showing typical applications as well as a valuable chart of bucket capacities, weights and dimensions. Bulletin No. 804 available by writing direct to the manufacturers.

Dynamometer for Wire Stretching

8. The Dillon Dynamometer and how its application steps up the efficiency and quality of various kinds of wire and fence installation, are described in an instruction bulletin issued by W. C. Dillon & Co., Inc., 5410 W. Harrison St., Chicago, Ill. The bulletin is amply illustrated with diagrams, and provides engineering information that anyone can use. A diagram shows how the unit may be shunted into existing wire installations that require increased tension or taking up of slack.

New Texaco Grease

9. For factory lubrication of tractor track rollers and other applications requiring a soft, water repellant, non-separating grease, The Texas Company has developed Texaco Star Grease No. 0. Made with lime soap, this product is heat stable and resistant to both water and oxidation.

CALCIUM CHLORIDE ROADS ATTRACT TOURISTS

Secondary roads, consolidated with calcium chloride, are firm, sound, smooth and dust-free. Roadside scenery is clean. Farm homes and crops are protected.

Your local scenic spots beckon tourists away from the paved arteries. Property values are enhanced; farmers' incomes are increased.

These excellent consolidated roads are low-cost. Local materials and local labor are used. They carry heavy traffic for long periods of time.

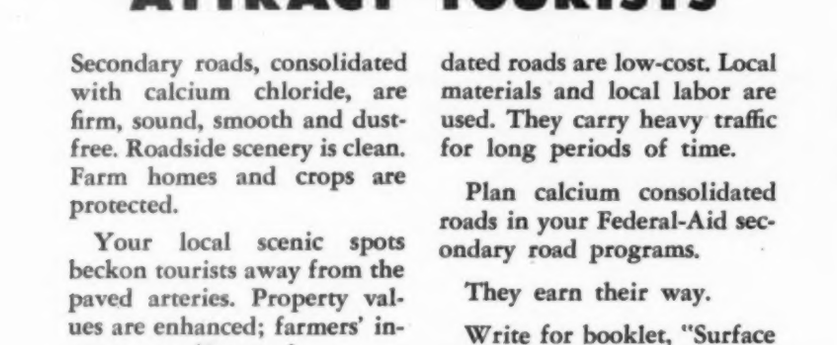
Plan calcium consolidated roads in your Federal-Aid secondary road programs.

They earn their way.

Write for booklet, "Surface Consolidation and Maintenance."

CALCIUM CHLORIDE ASSOCIATION

4145 Penobscot Building **Detroit 26, Michigan**



More Miles of Better Roads—

CALCIUM CHLORIDE

Consolidation

MANUFACTURERS' LITERATURE

Tandem Differential Manual

10. Truck operators interested in the improved mechanical performance of their machines will be specially interested in a publication "Thornton Automatic-Locking Differential," issued by Thornton Tandem Company, 8701-8797 Grinnell Ave., Detroit 13, Mich. In addition to providing full operating and maintenance data and a service parts list, this manual traces in words and pictures the story of the development of the differential, beginning over a century ago. It is said that the Thornton Differential is the first major improvement in full-locking differential assemblies that has been offered since the auto industry's inception. Of special interest is an illustrated chapter on a suggested method of field assembly.

Dual Crushing Plants

11. Specifications and practical advantages of the Lippman Self Propelled Dual Crushing Plant are set forth in a catalog bulletin by the Lippman Engineering Works, 4603 West Mitchell St., Milwaukee, Wis. This unit, powered by a Caterpillar diesel 150-hp. engine, is equipped with ten pneumatic tires, weighs 60,000 lb., and has a road clearance of 14 x 10 ft. The bulletin gives more detailed data for both dual and single axle models, along with typical details of equalizers and rear axle, tandem drive, transmission, steering gear and front axle.

Belting

12. A new belting catalog published by the Hewitt Rubber Division of Hewitt-Robins, Inc., Buffalo, N. Y., contains specifications on the company's wide line of conveyor, transmission and elevator belting sold under the brand names of Monarch, Ajax and Conservo. Maintenance suggestions advise users how to prolong the life of belts and avoid costly production delays. Many uses of the belts are illustrated by plant photographs; belt constructions are shown by sectional drawings.

Safety Guard Rail

13. Construction features of the Tuthill Hyway Guard are described in a new bulletin entitled "Tuthill Guard Rail," issued by Tuthill Spring Company, 760 Polk St., Chicago 7, Ill. Included are specifications of this rail, which weighs about 8 lb. per foot for 9-gauge metal including fittings. An explanation is given of the strength and effectiveness of the close-to-the-ground construction used. Also shown are typical details of installation across bridges as part of the railing, and as protecting separation strips between the roadway and walk on bridges or as median strip between roadways.

Steel Piling

14. Corrugated steel piling formed by the cold-rolling process is described in a catalogue on Caine-Corr-Plate steel piling issued by Caine Steel Co., Chicago, Ill. Diagrams, tables, dimensions and weights, given in the catalogue, make it easy to figure the requirements of any piling job, select the amount needed, and estimate the cost.

15. "Highways and Byways," an analysis of the equipment requirements of the impending road construction projects of the nation, has been published by Caterpillar Tractor Co., Peoria 8, Illinois. Conservative estimation of the earthmoving chores to be done during the next several years indicates some eight billion cubic yards of material will be moved each year with the building of roads, from country lanes to super-highways, comprising a large part of the task.

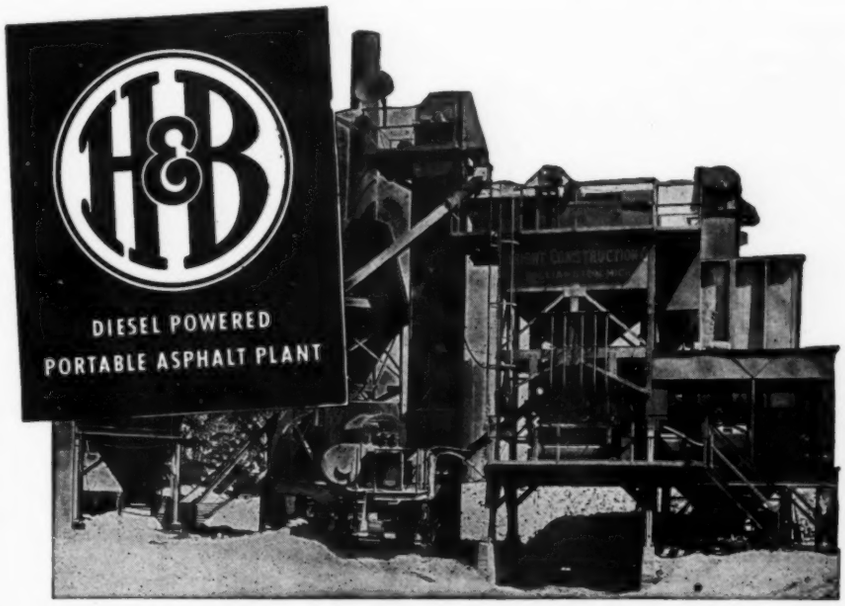
The profusely illustrated 16-page booklet shows some of the initial operations in the nation-wide program of highway construction and improvement and delineates the equipment requirements throughout each project. Copies of this booklet may be obtained by writing the manufacturer, requesting Form 9455.

A.S.T.M. Moves—The American Society for Testing Materials, which for a number of years has been located at 260 South Broad St., Philadelphia, Pa., has moved to its permanent headquarters building at 1916 Race St., Philadelphia. This building, which was purchased and remodeled through contributions made by many of the companies and individuals active in the Society's work, will provide much needed additional space that is required by the expansion of the Society's staff.

(*Continued from page 73*)

which after compaction gives a net height of 10.6 in. In Column 2, 22.02 is found to be the factor corresponding to a height of 10.6 in. By multiplying 22.02 by 5.2 the figure 114.504 is obtained which is the dry weight per cu. ft.

Columns 3, 4 and 5 give the weights per cu. ft. directly for a given cylinder height when an even 3 lb., 4 lb., or 5 lb. dry sample is used. Column 2 can be used in computing the weight per cu. ft. when sample of any other weight is used.



Tops in Asphalt Production

THE MOTO PAVER

The new H & B mixer and paver—self-contained and self-propelled—*mixes, spreads and lays* any type of mixed-in-place bituminous material to any road width, thickness and crown condition. Write for Bulletin M° 46

This Diesel powered Hetherington & Berner portable asphalt plant is engineered to give the volume, uniformity and economy of production which is needed for profitable peace-time operations. The Diesel power unit permits all units of the plant to be individually motor driven, thus eliminating many chains and countershafts and reducing maintenance costs. It also makes the operator independent of local power sources. Sectional type construction makes for quick assembly and disassembly, and for complete portability.

H & B builds portable and stationary asphalt plants of all sizes, types and capacities. Write for literature on the type of plant in which you are interested.

HETHERINGTON & BERNER INC. • 721 Kentucky Ave., Indianapolis 7, Indiana

Hetherington & Berner

Following is an example showing the method used in making correction for coarse rock:

Rock retained on 1 in. = 20%
Sp. Gr. rock ret. on 1 in. = 2.60
Dry Wt. per cu. ft. comp., pass. 1 in. = 124.8 lbs. or

$$\text{Weight ratio} = \frac{(124.8)}{62.4} = 2.00$$

$$\frac{\text{Weight ration of combined materials}}{\text{Volume}} = \frac{100}{\frac{A}{G1} + \frac{B}{G2}}$$

Where "A" equals the percent by wt. of rock ret. on 1 in.,

"G1" equals the apparent sp. gr. of rock retained on 1 in.,

"B" equals the percent by wt. of material passing 1 in., and

"G2 equals the $\frac{\text{Weight}}{\text{Volume}}$ ratio of compacted material pass. 1 in.

or

$$\frac{100}{\frac{20}{2.60} + \frac{80}{2.00}} = 2.10$$

Dry weight per cubic foot compacted, combined sample = (2.10 × 62.4) = 130 lbs.

(*Continued from page* 112)

A general average cost per mile for maintaining three types of shoulders in a northwestern state was reported as follows:

	Cost per mile
Earth	$50
Turf	52
Crushed rock	69

Although there is a wide variation in the cost of maintaining individual projects in the state, it was noted that where the pavement was of sufficient width to eliminate the formation of edge ruts, the cost of maintaining crushed rock-surfaced shoulders was low. The shoulders on one portion of a route carrying a heavy volume of traffic was kept in a very satisfactory condition with only four or five bladings a year at a cost of $25 per mile.

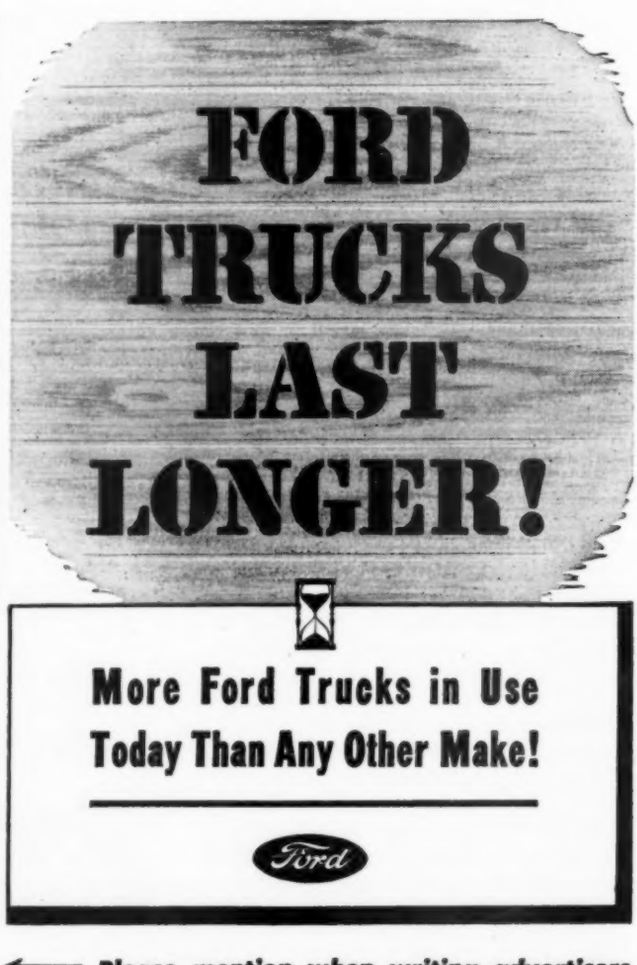
Drainage Ditches

Developments in machines for loading material trimmed from ditches and shoulders are lowering the cost of drainage maintenance. The following is a detail analysis of operations in a western state in which 61.9 miles of ditches were cleaned and reshaped in 15 days. There were 4,714 cu. yd. of materials moved and the total cost of the work was $3,030. This resulted in a cost of $48.96 per mile or $0.64 per cu. yd. of material moved. Average costs of similar operations by hand methods were reported as $0.90 to $1 per cubic yard.

Cost Analysis for Machine Method of Cleaning and Reshaping Ditches

Items	Dollars
Labor	$1,619.40
Medical attention and industrial insurance	42.05
Rental of state equipment	878.14
Rental of loading equipment	280.00
Provisions and supplies	210.83
Total	$3,030.42

Equipment used	Rental rate per day
1—F.W.D. truck	$16.00
1—Pull grader	10.00
1—Motor grader	8.00
2—Trucks ....each	6.00
2—Trucks ....each	5.00
1—Pickup	3.25
1—Loader	20.00



Center-line Traffic Stripe

The unit cost of maintaining a continuous center traffic line was reported as substantially higher than for a broken line. One northeastern state painted a line 15 ft. long with an interval of 25 ft. Ten gallons of paint were required per mile for a continuous line 4 in. wide while only 4 gal. of paint were required for the 4-in. broken line. Cost of the broken line, including cost of paint, labor and rental of equipment, was 45% of the cost of continuous center-line stripe.

A Pacific coast state reported that substitution of a broken line for a continuous line saved the state $90,000 in one year. The saving became available for other needed maintenance work. This well illustrates the value of unit cost comparisons of maintenance operations as a basis for developing efficiency in repairing practices and effecting reductions in expenditures.

Conclusions

1. Maintenance expenditures in the United States of six-tenths of a billion dollars per year on highways, roads and streets are of such magnitude as to emphasize the need of revaluing present maintenance practices, materials and equipment used to insure the highest degree of economy and efficiency.

2. Comparisons are now hampered by a lack of uniformity in units of measure in maintenance cost keeping.

3. Comparing costs on a lineal foot basis of filling joints and cracks in concrete pavements develops the range of costs as from ¼ to ⅝ cents per lineal foot. There is an indication that with increase in age beyond ten years that the costs per mile increase quite noticeably in the maintenance of joints and cracks. There are also indications that machine methods are quite markedly more economical than hand operations, possibly permitting a saving of 50%.

4. The patching of concrete pavements with bituminous materials costs from $0.25 to $1 per sq. yd. There are no satisfactory data as to the life of the patches.

5. The cost of patching concrete with concrete ranges from $4 to $6.70 per square yard. Work performed by state forces costs from 80 to 90% of the cost by contract. There are indications that the cost per square yard of concrete patch decreases with the increase in size of the patch.

6. The cost of drilling holes in concrete pavement for mud-jacking ranges from $0.07 to $0.23 per hole. Information on the cost of slurry, including pumping under the pavement, is meager; probably it is in the neighborhood of $10 per cu. yd. Information on the cost of pumping asphaltic mixtures under the pavement is also meager but it is probably around $0.12 per gal.

7. The reports on shoulder maintenance are not conclusive but costs vary with the type and the width of shoulders. As an illustration, one state reports the cost of maintenance of 8-ft. turf shoulders as approximately $94 per mile. This includes $19 for mowing, $50 for machining or rolling high places, and $25 for patching and seeding. The maintenance of crushed rock shoulders seems to be generally the most economical, ranging from $25 to $70 per mile.

8. Cleaning and shaping of drainage ditches, as would be expected, is reported to be more economical by machine methods than by hand methods. Useful comparisons can be made only when data are available on maintenance of ditches of similar design and in similar soils.

9. Cost of repainting of center-line traffic stripes indicates economy

ROAD MIX TAR RETREADS

OTHER *Reilly* CONSTRUCTION MATERIALS

- Plastuvia Crack and Joint Filler
- Creosoted Guard Rails and Posts
- Creosoted Bridge Timbers
- Creosoted Piling
- Bridge Paint
- Traffic Line Paint
- Concrete Curing Compound
- Wood Preservatives
- Pipe Enamel and Primer

● The use of BITUVIA Tar road-mix over broken and worn-out pavements is enabling many states and counties to obtain greater road mileage for the available manpower and funds. This type of construction and maintenance gives a very serviceable and satisfactory road at minimum cost.

BITUVIA is equally well designed for use in Plant Mix, Seal Coat, priming and all types of road maintenance and construction involving bituminous material. Available in grades to meet all standard specifications. Send for the pocket-size BITUVIA manual.

REILLY TAR & CHEMICAL CORPORATION
Merchants Bank Bldg., Indianapolis 4, Indiana
2513 S. Damen Ave., Chicago • 500 Fifth Ave., New York 18

in the use of the broken center line in lieu of the continuous line. One state indicates a saving of 55%.

10. An analysis of maintenance expenditures over a period of years on representative sections of road discloses that on the average, 45% of the expenditures are made for direct labor, 21% for materials, 25% for equipment and 9% for overhead.

Obituaries

Henry C. Porter Dies

Since publication of our June issue word has come of the passing of Henry C. Porter, Research Engineer with the Texas State highway department. Mr. Porter was credited as the inspiration for the article by V. C. Brown in June Roads and Streets entitled "Elastic Limit Basis for Determining Load Supporting Power of Soil Structures." Mr. Porter in his long service with Texas made a national reputation in soils and other highway research.

C. M. McCullough, assistant state highway engineer of Oregon and widely known as the author of books of bridge engineering and engineering law, died recently at Salem. Mr. McCullough was for a long time bridge engineer of the department and his published works on bridges, including many technical articles are familiar to many. At the time of his death he had just published a two-volume edition of "Law for Engineers."

Lester A. Blackner

Lester A. Blackner, a member of the State Road Commission of Utah for the past five years, died in Salt Lake City on June 14.

Prior to serving in the Road Commission, Mr. Blackner had been prominently associated with the mining industry for 30 years. He received his degree in mining engineering at the University of Utah in 1910.

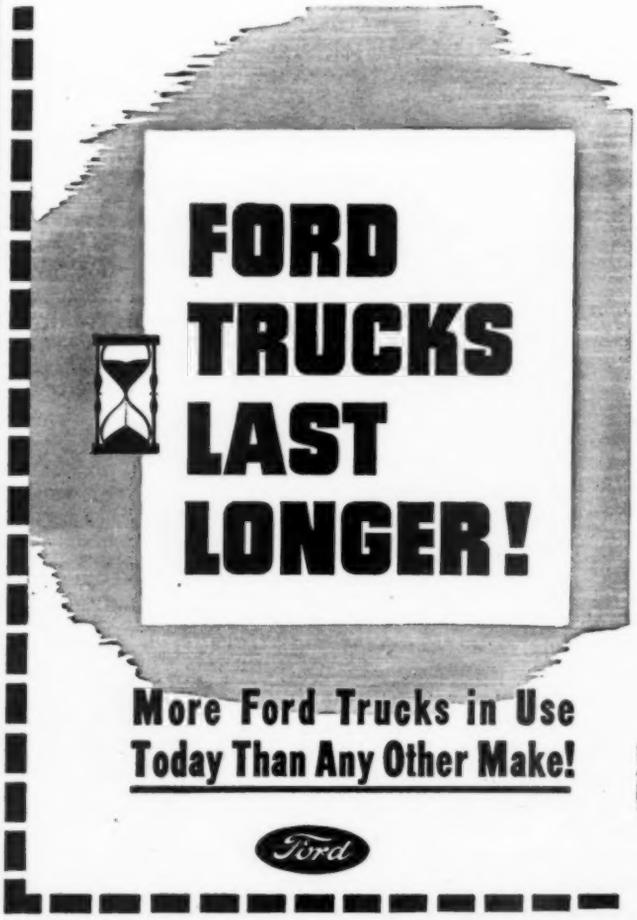
He early joined the Ray Consolidated Copper Company, Ray, Arizona, and was engineer in charge of construction at the outbreak of World War I, during which he served as captain of engineers.

He was associated with various mining companies, including the Utah Copper Company, and for several years was plant manager for the properties of the St. Joseph Lead Company in Tres Cruces, Argentina, where in 1937 he built a $1,000,000 plant for treating lead, zinc and silver ores. Mr. Blackner was in the employ of the Army at Ogden Airport, Hill Field, immediately prior to becoming a member of the Road Commission.

•

George E. Hamlin, a pioneer in Connecticut highway maintenance, died recently. In 1913 he was appointed assistant to the late William LeRoy Ulrich, then superintendent of repairs in the Connecticut state highway department. In 1918, he was appointed special assistant, in which capacity he continued until July 1, 1923, when he was appointed by the late John A. Macdonald to the position of superintendent of repairs. In 1931 the title was changed to deputy commissioner for maintenance. Mr. Hamlin continued in this title until his retirement in 1939.

During his 16 years' service for the state highway, many advancements in maintenance methods were made.



WITH THE MANUFACTURERS & DISTRIBUTORS

Texas Firm Change

H. W. Lewis Equipment Company announces the manufacturing phase of its business, which consists of the making of the Pierce Bear Tandem Road Rollers and other construction equipment, has been incorporated under the name of Lewis Manufacturing Co. and will continue to be located at 415 Hoefgen Avenue, San Antonio, Texas.

Appointed Regional Manager

L. S. Riedel has been appointed regional manager of the Construction Equipment Division of the Worthington Pump and Machinery Corporation with offices at 748 Bruckner Blvd., Bronx, New York.

Williams to Clay Pipe

The Clay Sewer Pipe Association, Inc. announces the addition of Frank M. Williams to its technical staff. Mr. Williams has been connected with the Ohio State Department of Highways since 1923 except for three years' service with the United States Signal Corps between 1943 and 1946, advancing to rank of Captain. With the Ohio highway department he was Executive Assistant to Highway Director and later Engineer of Sales.

Mr. Williams is to be District Engineer of the Clay Sewer Pipe Association representing the State of Ohio and will be located in the headquarters office at 1105 Huntington Bank Building, Columbus 15, Ohio.

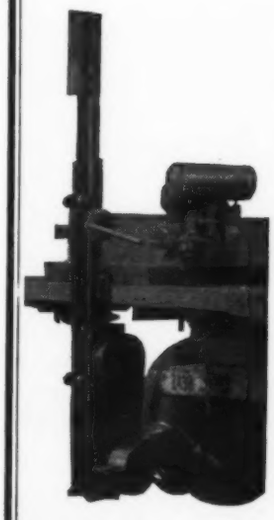
C. M. Gile, Gulf Vice-Pres.

Clement M. Gile has been elected Vice-President of Gulf Oil Corporation and the Gulf Refining Company, and also Vice-President and a Director of the Gulf Research & Development Company, succeeding W. V. Hartmann, retired. He will be in charge of marketing. Mr. Gile joined the Gulf Companies in January, 1926, as assistant to the general manager of sales. He was appointed general manager of refined oil sales in May, 1933. He has been vice-president of the Gulf Tire and Supply Company since it was organized.

Stevens Promoted by Firestone

N. B. Stevens

Norman B. Stevens has been appointed Chicago manager of the Manufacturers' Sales Department of The Firestone Tire & Rubber Co., Akron, O. He joined Firestone in 1917 as a salesman at Des Moines, Iowa, and has been Manufacturers' Sales Representative in the Chicago area since 1933. In his new position, he will direct Firestone contacts with the Earth Moving Machinery, Farm Equipment, Passenger Car and Truck Manufacturers in the Chicago area.



NOW
THE MODERN
SPENCER POWER
DRIVEN STEEL POST
DRIVER

Does the work of 8 men with only 2 men. THEY HAVE BEEN PROVEN IN THE FIELD. SEVERAL STATE HIGHWAY DEPTS. HAVE USED THEM THIS SEASON.

ALSO

COUNTY HIGHWAY DEPTS. HAVE USED THEM FOR TWO YEARS AND ARE ENTHUSIASTIC USERS.

Power take-off
or
Motor Driven.

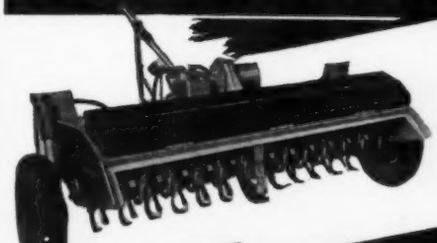
Will drive 1,000 to 2,000 snow fence posts per day with only two men and with less labor than they would do it by hand. Simply load up the truck with posts and while they are being distributed, in very little more time they can be driven. Mounts on truck or tractor. Saves posts, trucks, labor, and time at the season when they all are so necessary. Write for full particulars and further information.

Distributed by:

MURRAY SALES, INC.

302 Insurance Exchange Building,
Sioux City 13, Iowa

THE MOST IMPORTANT UNIT ON
SOIL - CEMENT CONSTRUCTION



The swirling, chopping action of these tines does a thorough job of mixing.

ARIENS AGGMIXER

HERE'S equipment designed especially for mixed-in-place construction, operating in connection with other general purpose road equipment. It may be used wherever aggregates are used—bitumens, cements, clays, chlorides, etc., mixing these materials with the aggregates without displacing on the road surface. Ariens AGGMIXER does a thorough job of pulverizing, mixing and aerating the aggregates with whatever binder used.

It is safe and easy to operate—and adjustable to any tractor. Made in four sizes, with normal cutting widths 4', 5', 6', and 7'.

Write for complete job facts and name of nearest distributor.

ARIENS COMPANY
BRILLION, WISCONSIN

ONLY JAHN TRAILERS GIVE YOU ALL THESE FEATURES

1 Improved, fabricated gooseneck with its greater built-in strength.

2 Positive, equalized braking at each wheel regardless of position of axle.

3 Deep wide flange main beams run the full length of the trailer.

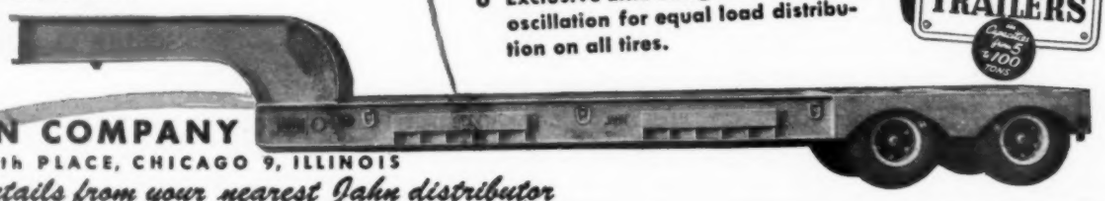
4 Worm gear type slack adjusters at each wheel.

5 Constant lift cam provides improved brake application.

6 Exclusive axle designs furnish ample oscillation for equal load distribution on all tires.

JAHN *Heavy Duty* TRAILERS

Capacities from 5 to 100 TONS



C. R. JAHN COMPANY

1345 WEST 37th PLACE, CHICAGO 9, ILLINOIS

get all the details from your nearest Jahn distributor

Heil Entertains Latins

International cooperation of a practical nature was demonstrated recently when The Heil Co. of Milwaukee played host to 19 engineers, representing as many foreign countries, and unveiled many new road machinery developments for the first time. The visitors are shown herewith climbing over the new Heil bulldozers and huge rubber-tired, high-speed scrapers and watched them operate on the testing grounds. The engineers had completed a five week's Inter-American highway course in the National Academy of Science building in Washington and were on a five-week tour sponsored by the American Road Builders' Association, with the cooperation of the State Department, Office of Inter-American Affairs, Public Roads Administration, and Pan American Highway Confederation.

The South and Central American nations represented here and their engineers are: Argentina, Mark Kivilevich and Juan Jose Vistalli; Bolivia, Roger Marie de Barneville; Brazil, Paulo Muller de Aguiar, Ricardo Mendes Goncalves and Jose Marie Carre; Chile, Francisco Ramon Dick and Jorge Recardo Sierralta; Colombia, David Morenso; Costa Rica, Frederico Baltodano; Cuba, Juan Ignacio Planas; El Salvador, Geraldo Guillermo O'Byrne; Ecuador, Miguel Salem; Honduras, Rafael Alejandro Cervantes; Mexico, Hector Pena and Gustave Alejandro del Rio; Panama, Rodolfo Florencio Alvarez; Paraguay, Hugo Jorge Seifart; Peru, Jose Felix Ventocilla; Uruguay, Luis Bancalari; and Venezuela, Rafael Recao.

ASPHALT and TAR KETTLES

FIRE PROOF—OIL BURNING

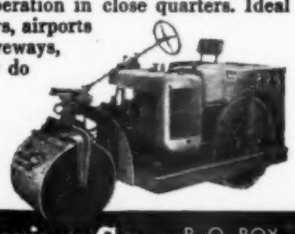
Hand and Motor driven spray.
Many sizes. Write for catalog.

Elkhart White Mfg. Co. Indiana

Try a **Pierce·Bear** *on that tough job!*

3½-5 TON — VARIABLE WEIGHTS

Engineered refinements and rugged strength have earned for these rollers enviable performance records. Compact design gives efficient operation in close quarters. Ideal for maintenance work on highways, airports and parking areas. Fine for driveways, docks, etc. Easy to operate. They do a good job at low cost.



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Lewis Manufacturing Co. P O BOX 500

SAN ANTONIO 6 TEXAS

D. M. Klausmeyer New President

Bert Dingley retired on July 1 as president of Marmon-Herrington Co., Indianapolis, Ind. He was succeeded by David M. Klausmeyer, who resigned as plant manager of Chevrolet Commercial Body Division of General Motors Corporation to join the Marmon-Herrington organization. Mr. Dingley's retirement climaxes a long and colorful career in the automotive industry. He joined Marmon-Herrington in January, 1932, as vice president, just a few months after the company was founded. This position he held until August, 1942, when he was elected president of the company. In succeeding Bert Dingley as president of the Marmon-Herrington Co., David M. Klausmeyer is well qualified both by education and experience for this important position. A mechanical engineer by profession, Mr. Klausmeyer has been identified with the automotive industry all of his business life. He joined the Chevrolet Division of General Motors in 1924, after spending three years in body design and manufacture with various factories, and remained with that division continuously for 22 years.

Bert Dingley

D. M. Klausmeyer

Gar Wood Gets New Plant

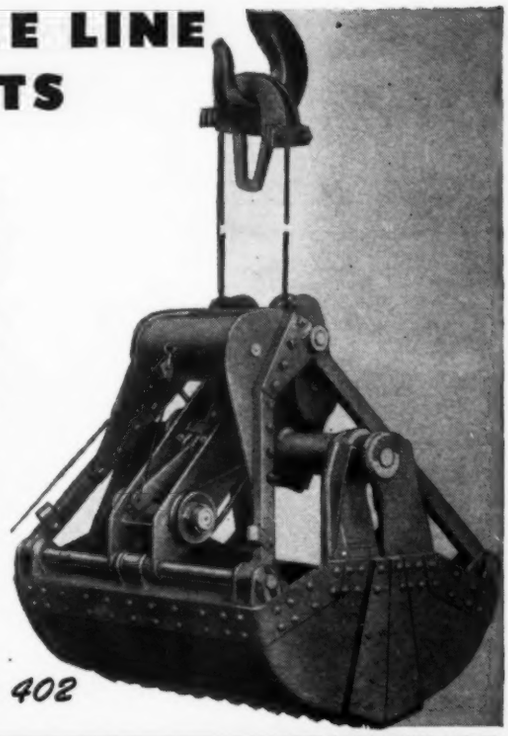
In order to meet the sharply increased demand for its products, Gar Wood Industries, Inc., has expanded its manufacturing facilities by purchasing from the War Assets Administration the former Bendix plant in Wayne, Michigan. The company will transfer all its Detroit operations to the new site with the exception of its body plant which will remain on Connecticut Avenue. When the new plant is in full operation, it is expected that Gar Wood employment in the Detroit area will rise to 3,500 from the present 1,500.

Gar Wood will manufacture in its new plant hydraulic hoists, steel bodies, winches, cranes and derricks for motor trucks, hydraulic systems and attachments for bulldozers, scrapers and other tractor equipment; oil burners, gas burners, oil and gas-fired hot air heating units, oil and gas-fired boiler units, ventilating fans and hot water heaters.

Named Consulting Engineer

Steven F. Evelyn has been named consulting engineer of construction equipment products of Worthington Pump and Machinery Corporation, with headquarters in Holyoke, Mass. Howard Platts succeeds him in his former position of chief engineer of the Portable Compressor Division.

ERIE SINGLE LINE BUCKETS



ILLUSTRATED is the hook-on type, for intermittent service. It is reeved and ready for operation on overhead traveling crane, monorail hoist, locomotive crane, derrick, ships tackle or any other hoisting device which has but a single hoisting drum available for bucket duty. Just slip the yoke over the crane hook.

Erie Single Line buckets are also available in the direct-reeved type for permanent installation. Describe your Single Line bucket need — we'll give you our recommendations for we build all types and sizes.

● *Write for Booklet 402*

ERIE BUCKETS • *A Complete Line*

Erie Steel Construction Co., 367 Geist Rd., Erie, Pa.

BUCKETS • AGGREMETERS • PORTABLE CONCRETE PLANTS

There's a *La Crosse* Trailer for Any Load . . 3 to 200 Tons

RUGGED

"TWO-FISTED" PERFORMANCE

Look to the LA CROSSE Line of ALL WELDED Trailers to Meet the Most Exacting Work Requirements.

LA CROSSE TRAILER CORP. LA CROSSE, WISCONSIN

CLEARING HOUSE

FOR SALE

1—Foote Paver $3,000.00
1—Huber Roller, Gas, 10-ton—3-wheel 1,250.00
3—Steam Tandem Rollers (Prices vary
1—Barber Asphalt Plant, 2,000 lb. box 1,500.00
1—Barber-Greene Ditcher... 2,500.00
2—Drott Universal Bull Clam Shovels (New), each..... 500.00
1—Buckeye Sub Grader, 10' to 12' 3,250.00
1—McCormick-Derring Power Unit, 40 H.P., gas, in perfect condition 500.00
1—Iroquois Asphalt Plant 2,000 lb. box..... 15,000.00

PHIL H. McQUIRE
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AIR COMPRESSORS

Curtis Two-Stage Air Cooled 5¼ H.P. Briggs & Stratton Engine

Compressor, two-stage, size low cylinder, Bore 4-3/16, stroke 3½. High cyl. 2⅛x3½. Air cooled. Displacement—17 C.F.M. at 200 lb. pressure. 24 C.F.M. at 100 lb. pressure. Engine Briggs & Stratton 5¼ H.P. Air Cooled Model Z. Air receiver six 16 x 44 A.S.M.E. Complete with centrifugal unloader, (unit idles when maximum pressure reached). Safety valve, pressure gauge, draincock, 4 air discharge outlets, 50 ft. air hose. Manufactured by Curtis Compressor Co., St. Louis, Mo. Brand new in original factory crates. Shipping weight 700 lbs. Can be operated with 3 or 5 H.P. electric motor.

Regular $475.00 Value for $348.00
F. O. B. Chicago or Youngstown, O.

J. & H. EQUIPMENT CO.
Dept. 12, 1132 S. Canal St.,
Phone Webster 7770 Chicago 7, Ill.

HEAVY EQUIPMENT FOREMAN wanted with experience in operation and maintenance of Road and Building equipment. Capable taking charge of road construction. Should speak some Spanish. State experience, salary wanted. Location Panama City, Panama.

BUILDING SUPERINTENDENT wanted capable of directing building operations of long established firm constructing homes, apartments, schools, warehouses. Should speak some Spanish. Permanent position. Salary commensurate with ability. Location Panama City, Panama. Send experience and reference.

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ROAD MACHINERY LINES

Distributor widely known in engineering circles and well qualified in the distribution and service of road machinery and contractors' equipment will consider additional lines for the Canadian market.

The principals of this Company are men of long standing in the industry and have manufactured, sold and serviced internationally known equipment over a period of many years. Makers of lines now handled know of this advertisement.

If you want stable, aggressive representation in the Canadian market, write to

Box No. 211, Roads & Streets,
330 So. Wells Street, Chicago 6, Illinois

— NOTICE —

The Virginia Department of Highways Needs Road Building Equipment

Will Purchase or Rent

Crawler Tractors with Angledozers or Bulldozers.
Motor Patrol Graders.
Power Shovels and Cranes.
Crushing Plants, etc.

If any of above equipment is available, contact:

Equipment Engineer,
Department of Highways
Richmond, Virginia

FOR SALE

(Subject to prior sale)

Koehring 27E Paver. Serial No. 16409, first class working order. Has new Drum as stand-by.

Flexible Road Joint Finishing Machine, 18 feet to 25 feet, with double screed.

Quantity of 8 and 9 inch Steel Forms.

6 inch Rex Pumpcrete.

Two Buffalo 8-10 Ton Tandem Rollers.

Location: El Paso, Texas.

HENRY THYGESEN & COMPANY
P. O. Box 876
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FOR SALE

Brand new 1½ c.y. Link Belt Speeder 1946. Series 300. Used two months. Available in 60 days.

Two LS85 heavy duty ¾ Link Belt Speeder Shovels with combination attachments.

One 40A Loraine with shovel and attachments.

Eight FN 1942 Mack Trucks. Heavy duty —6 c.y. WL. body. Excellent for rock work.

Three 1946 Ingersoll Rand 315 C.R. Compressors with new wagon drills. Used two months. Mounted on pneumatic tires. International Diesel power.

One 1946 Jaeger 315 Compressor. International Diesel Power. Mounted on pneumatic tires. Used six weeks.

The above equipment is now working and project will be completed within 60 days. Ceiling prices and under. Contact:

GENERAL SUPPLY CO.
Box 55 Bridgeport, Conn.

FOR SALE

Northwest Dragline, 1¾ yd. bucket, 40 ft. boom. Caterpillar Tractor with LeTourneau Bulldozer. Adams 12 ft. Tandem Drive Motor-Grader. 5 Trailer type Bottom dump Euclids, 9½ yd. Priced for quick sale as a unit or will sell hauling equipment separately.

Box 201, Roads & Streets,
330 So. Wells St., Chicago 6, Ill.

Wanted: Used Wheel Barrows, Roller, Scraper, Mixer.

Arthur Ley
La Plata Maryland

FOR SALE

Late model DEMPSTER DUMPSTERS, LF-200, including buckets $500.00
New Quick-way Truck Crane, model E, including ½ yd. dragline bucket. Present factory price less 5% 160 cu. ft. actual SCHRAMM 2-stage compressor, mounted 2-ton Indiana truck. Bargain.... $1,750.00
315 cu. ft. latest model SCHRAMM Portable Compressor. Like new..... $2,600.00

M. Wenzel, 2136 Jefferson, Kansas City, Mo.

FOR SALE

2 Buffalo Springfield Steam Tandem Rollers. 1-eight ton, 1-ten ton, $500 each. Location Long Island City, N. Y.

Box 210, Roads & Streets
330 So. Wells Street Chicago 6, Ill.

EXCEPTIONAL BARGAIN

Immediate Shipment

1—Barber-Greene model 558 Snow Loader —Nearly new.

PAUL L. MATCHETTE COMPANY
Tel.: Day—HA. 4166; Night—HI. 3377
Distributors for Barber-Greene Co.
705 Walnut St. Kansas City 6, Mo.

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GUTTER-SNIPE
PICK-UP STREET SWEEPERS
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Since 1908
MUNICIPAL SUPPLY COMPANY - SOUTH BEND 23, INDIANA

RELIANCE
CRUSHING, SCREENING and WASHING UNITS
● Up to 2000 Tons a Day ●
Crushers, Elevators, Sweepers, Screens, Wash Boxes
Bins, Pulverizers, Feeders, Spreaders, Kettles, Conveyors
Drag-Lines, "GAYCO", Centrifugal Air Separators
UNIVERSAL ROAD MACHINERY CO.
Kingston, N. Y.
Canadian Representatives: F. H. Hopkins & Co., Ltd. 140 Canada Cement Co., Montreal, Que., Can.

Personnel Changes in Truck Division, International Harvester

W. C. Schumacher, general manager of International Harvester Co.'s motor truck division, has announced several new and important changes in top motor truck sales personnel. L. W. Pierson, who started with International Harvester in 1922 and who for the past 2 years has been Southwest motor truck district sales manager, has been appointed assistant manager of sales specializing on national and fleet account sales. R. M. Buzard, who also entered Harvester's employ in 1922 and who for the past 2½ years has been motor truck district manager of the Western District, has also been appointed assistant manager of sales specializing on operational phases of the business. While, as indicated, these men will specialize to some extent they will on the other hand share with W. H. Perkins, manager of sales, the full operating responsibilities of the motor truck division sales department. At the same time Mr. Perkins announced the following changes in motor truck district managerships: J. T. Sullivan, formerly Central District manager, has been transferred to the Southwest District replacing Mr. Pierson. R. S. Byers, formerly manager of the Eastern District, has been transferred to the Western District replacing Mr. Buzard. R. W. Dibble, formerly manager of the sales operation research department, has been appointed manager of the Eastern District. E. H. Watkins, formerly assistant district manager, Eastern District, has been appointed manager of the Central District. As announced several days ago W. A. Riggs, former Central District Manager, has been transferred to the Northwest District. Karl W. Freeman remains as district manager of the Southern District.

•

McLean Named Sales Manager

L. O. McLean

L. O. McLean has been appointed sales manager of The General Excavator Co., Marion, O. He succeeds Don B. Smith, who has resigned. Mr. McLean has had extensive experience in the construction and construction equipment industry where he is widely known. He founded the McLean Construction Co. in Pittsburgh and later entered the sales field as a distributor for The Osgood Co. and other manufacturers of construction and excavating equipment. Then he was Eastern sales manager for the Michigan Power Shovel Co. Since joining The General Excavator Co., in 1920 Mr. McLean has assisted in developing a comprehensive distributor organization throughout the country. Although his headquarters and home will remain in Marion, he will continue his field trips as sales manager and will cover all important conventions and equipment shows.

•

A. M. Byers N. Y. Appointment

A. M. Byers Company of Pittsburgh, Pa., manufacturers of wrought iron, has just announced the appointment of Buckley M. Byers as assistant manager of the company's New York Office located at 30 Rockefeller Plaza. Mr. Byers will be in charge of export sales. A grandson of the founder of the firm, Mr. Byers recently returned after nearly four years service in the U. S. Navy. He held the rank of senior lieutenant and was on duty in both the Atlantic and Pacific. He is a graduate of Yale University.

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available from Stock for immediate Delivery
CONVEYOR, ELEVATOR and TRANSMISSION BELTING
all widths and plies
V-BELTS all sizes
HOSE
all sizes and types
AIR, FUEL, FIRE, WATER
DISCHARGE, COMPRESSOR, PILE DRIVERS, ROAD BUILDERS
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BOOTS, DREDGE SLEEVES, PUMP DIAPHRAGMS, ETC.
. . . and everything rubber for Industrial Requirements
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ARE MADE in a complete line of sizes to fit all standard compressed air hammers.
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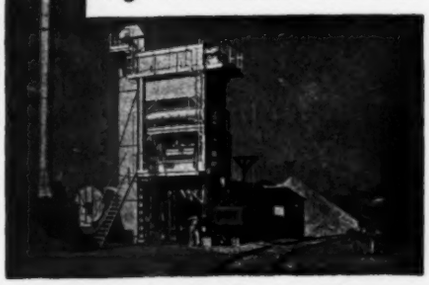
VULCAN TOOLS — THE WORLD OVER — NOTED FOR QUALITY AND DURABILITY"
VULCAN TOOL MFG. CO.
QUINCY, MASS.

PORTABLE ASPHALT PLANTS
High Production—Low Cost



THE McCARTER IRON WORKS, INC.
NORRISTOWN, PENNA.

Two Safe, Reliable Couplings Designed to Protect Hose...

Corrugated stems are smoothly finished to prevent damage to tube while coupling is being attached to hose. "Boss" Offset and Interlocking Clamps, when pulled up, tighten evenly around the entire perimeter of the hose without cutting or pinching.

"G J-BOSS"
Ground Joint, Style X-34
FEMALE HOSE COUPLING

The ultimate in coupling quality, efficiency and safety. For high or low pressure steam, water, hydraulics, air. Ground Joint construction provides washerless, leakproof seal between stem and spud. Large wing nut facilitates coupling and uncoupling. Sizes: ½" to 4", inclusive.

* * *

Note: For washer type couplings of otherwise identical design, specify "Boss" Couplings, Style W-16.

"BOSS" MALE COUPLING
STYLE MX-16

Companion to "G J-Boss" and "Boss" Female Couplings. Strongest and safest of its type for all applications including oil, butane, hydraulics. More convenient and economical than regular iron pipe nipples, as each size fits same size straight end hose. Can be quickly reset on the job. Sizes: ¼" to 4", inclusive.

Stocked by Manufacturers and Jobbers of Mechanical Rubber Goods.

IF IT'S A DIXON BOSS PRODUCT

IT'S DEPENDABLE

DIXON
VALVE & COUPLING CO.
Main Office and Factory: PHILADELPHIA, PA.
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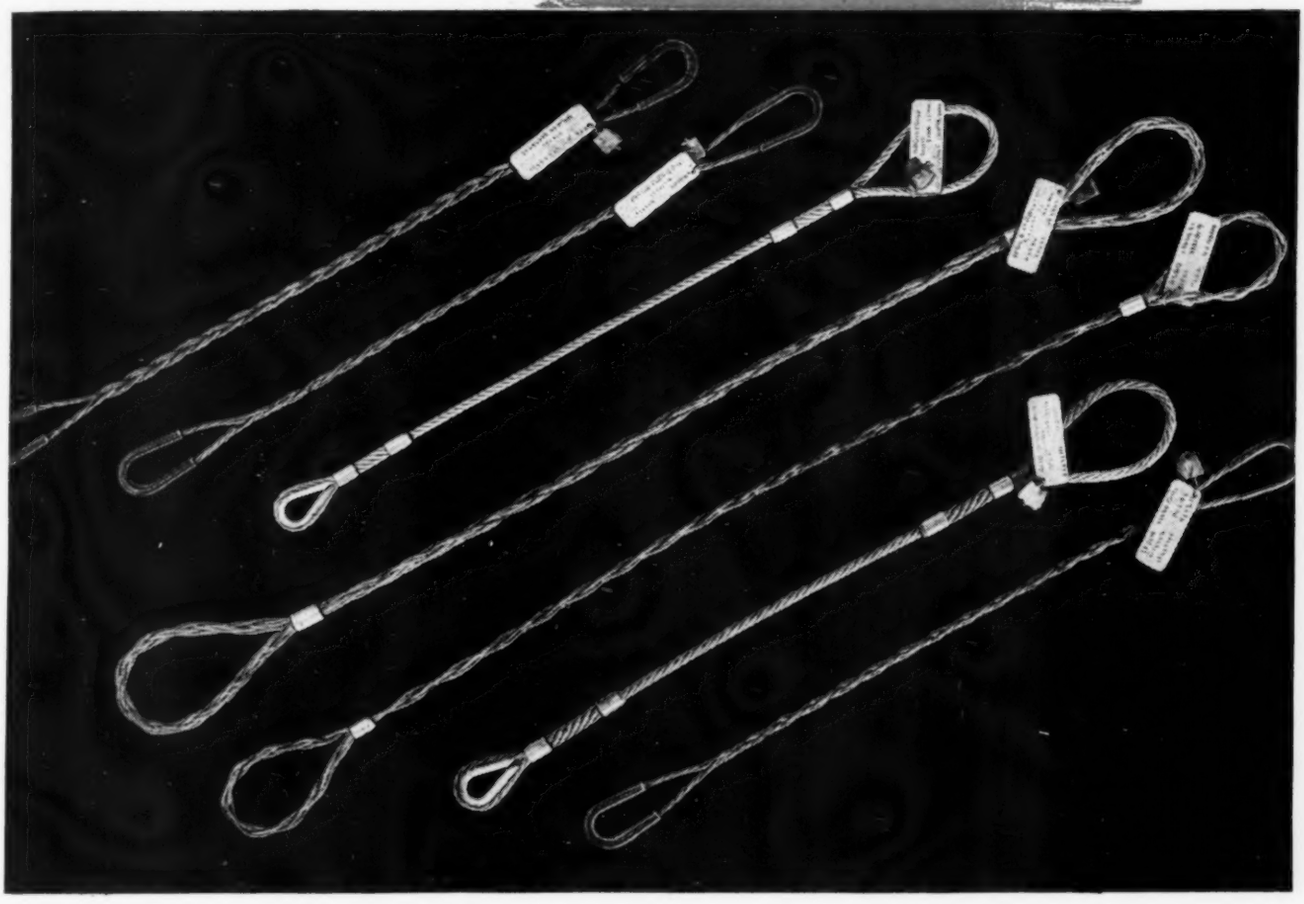

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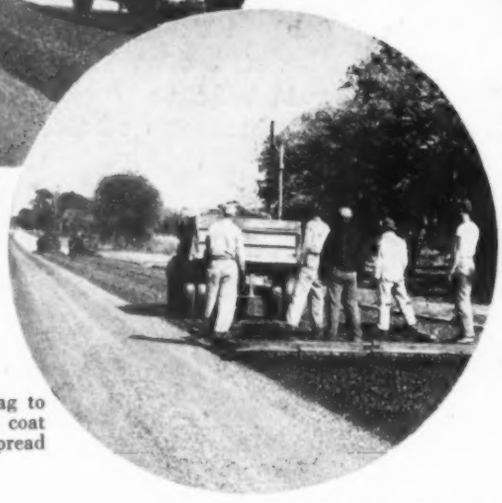
How to give an old street a smooth skidproof surface, using low-cost Texaco construction

A new Texaco Asphalt surface of the low-cost type, laid over the old pavement on main thoroughfare of Clearwater, Fla., by L. J. and W. L. Cobb.

Applying seal coat of Texaco Cutback Asphalt to street in Clearwater.



Using broom drag to mix Texaco seal coat with previously spread stone chips.

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